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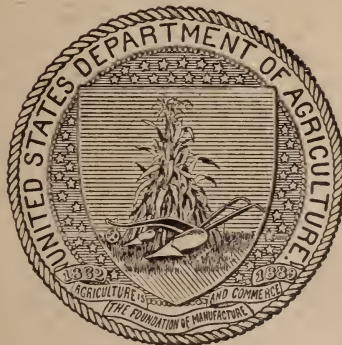
L. O. HOWARD, Entomologist and Chief of Bureau.

AMERICAN BLACK FLIES OR BUFFALO GNATS.

BY

J. R. MALLOCH,
Entomological Assistant.

ISSUED APRIL 6, 1914.



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BUREAU OF ENTOMOLOGY.

L. O. HOWARD, *Entomologist and Chief of Bureau.*

C. L. MARLATT, *Entomologist and Acting Chief in Absence of Chief.*

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D. C., October 20, 1913.

SIR: I have the honor to transmit herewith a manuscript entitled "American Black Flies or Buffalo Gnats," by J. R. Malloch, an entomological assistant in this bureau. This paper deals with a group of flies of considerable economic importance. As pests to man and domestic animals certain species of the group have long attracted attention in this country and elsewhere. Recently additional interest in these insects has been created by the theory that certain species transmit pellagra. This theory has not been proven and it is not accepted by the great majority of investigators. Nevertheless the importance of the buffalo gnats as pests to man and domestic animals is so great that accurate information regarding the species which exist in this country is highly desirable. This paper includes descriptions of several species new to science and in other respects adds very materially to our knowledge. I recommend the publication of this manuscript as Technical Series No. 26 of the Bureau of Entomology.

Respectfully,

L. O. HOWARD,
Entomologist and Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.



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AMERICAN BLACK FLIES OR BUFFALO GNATS.

INTRODUCTION.

Both in Europe and in America some of the species of the family Simuliidæ have for years been regarded as being among the worst of insect pests, and in some cases as a menace to the lives of cattle and even of human beings. The common species, *Simulium columbaczense* Schonbauer, of southern Europe, has the reputation of being very destructive and, if credence be given to records, it certainly equals the evil reputation of any other bloodsucking species in so far as the effects of its attacks on cattle are concerned. Lately there has been a suggestion made that some species of this group may be the transmitter of pellagra, and it is to ascertain how many American species occur (in so far as our material permits) and their range that this work has been undertaken. That there are more species than are listed or described in this paper there can be no doubt, but in view of the fact that the early stages of the species are passed in streams, from which it is not easy to remove them and successfully rear them under artificial conditions, a number of closely allied species have not been so far linked up in the adult, pupal, and larval stages. It is essential to the existence of the larvæ that they shall remain in water in which there is a current, and removal to water in a jar or vessel generally kills them after a few hours. The material available for study for the purposes of this paper consists of the collection in the U. S. National Museum and a few specimens kindly loaned by Prof. O. A. Johannsen and Mr. C. W. Johnson. Much of the material in the National Museum was collected by Messrs. A. H. Jennings and W. V. King in connection with the pellagra investigations in North Carolina and South Carolina in 1912.

It is not considered necessary to rewrite the history of the Simuliidæ in this paper, but a bibliography is given on page 69 of the principal papers on the American species in the group, which may be consulted with reference to the biology of the species.

CHARACTERS OF THE GROUP.

EGGS.

The eggs are deposited in many cases on blades of grass, twigs, or leaves of trees which are dipping in running water. According to

observations by Jennings and King the females select a twig, leaf, or blade of grass which is suitable, and approaching the margin of same nearest the water commence ovipositing thereon. The number of eggs deposited is very large, and generally several females oviposit on the same leaf, the combined weight of the eggs serving to submerge the leaf or blade of grass and provide the necessary conditions for the emergence of the larvæ. It has been placed on record that the species which oviposit on rocks have the faculty of entering the water to oviposit on the submerged rock surface. The egg masses on rocks are of very considerable extent and must amount to thousands in number. When first deposited they are covered with a peculiar slimy coating and being pale yellowish in color are very conspicuous, but later on they become darkened and whether on leaves or rocks are not so noticeable. It has been stated by Horvath¹ that the female lays from 5,000 to 10,000 eggs. This is undoubtedly an exaggeration, and the estimate was probably arrived at by considering the accumulated mass deposited by a number of females as being the deposit of only one. The eggs are elongate-oval and are very closely packed together on whatever surface they may be deposited. The egg stage occupies about a week, but is affected by weather conditions and also by the date of deposition.

LARVA.

The larvæ are cylindrical in shape, attenuated in the middle, and thickened at each end, most distinctly on the posterior third. In length they vary from about 8 to 15 mm. and possess, besides the head, 12 segments. They vary considerably in color, being almost entirely black in *pictipes* and pale yellowish-white, with slightly darker cross-bands on the segments, in *venustum*. The chief characters of use in distinguishing the species are found in the mouthparts.

The head (Pl. VI, fig. 1) is chitinized and slightly flattened. On each side there are, in all the species which I have examined, two irregularly shaped, black, approximated eye-like spots. On the dorsal surface, well forward and near to the bases of the fans, are situated the three-jointed antennæ (see Pl. VI, fig. 3). The fans (Pl. III, fig. 5) are composed of a large number of rays (Pl. VI, fig. 7) which vary in number, and generally in structure, in the different species. The function of these fans seems to be that of guiding food into the mouth cavity, moving on an articulated stalk and meeting, when brought forward closed, over the mouth opening. The mandibles, which in most cases furnish characters in their dentation for differentiating the species (Pl. III, figs. 1, 2), are situated lower on the head than the fans, and move so as to close pincers-

¹ "Le moucheron de Colombatch," *Rovart. Lapok.*, 1 Band, pp. 195-204.

like over the oral orifice. The maxillæ (Pl. III, fig. 6), which are situated below the mandibles and nearer the center of the mouth, are useful also in separating the larvæ of the different species, though the characters are difficult to see. The labium is heavily chitinated, and presents, in the toothing of its anterior margin, characters which appear to be constant and of a more accessible and a more easily appreciable nature than either the teeth of the mandibles, the shape and bristling of the palpi, or the structure of the antennæ. This organ (Pl. III, fig. 3) presents in the two species of *Prosimulium* (*hirtipes* and *pecuarum*), which have been described in the larval stage, a variation in the structure of the teeth which is clearly distinguishable from that of any of the larvæ of the genus *Simulium* with which I am acquainted. In these two species the central tooth is trifid, and the other teeth are irregularly bifid, or at least not simple as in the species of *Simulium*. Johannsen, on plate 35 in his work on this group, figures the labium of a species from Leland Stanford, Jr., University campus, which very probably is that of a *Prosimulium*. It is generally unsafe to accept distinguishing generic characters of this nature without an extended examination of a large amount of material, and I have not used this in my differentiation of these genera, but it is obvious that it is permissible to indicate its existence and possible significance.

In addition to the mouthparts, already indicated as of importance in the separation of the species, it will, I believe, be found by careful examination that the other parts with which I have not dealt in this paper supply characters of very considerable importance. On the ventral surface of the first segment is an elongated, rounded, and slightly conical proleg, the apex of which is furnished with a number of rows of hooks. This proleg is used by the larva in its movements from place to place in much the same manner as the larvæ of the Geometridæ use the legs on their anterior segments, and their method of progression is somewhat similar to the well-known "loopers" of this family of moths. When disturbed, the larva releases its hold on the rock or other surface and floats down stream attached by its proleg to a silk thread which it emits from the mouth, regaining its former position by means of this thread. At the anal end is a sucker-like disk, around the margin of which are arranged concentric circles of minute hooks similar to those at the apex of the proleg. It is by means of this anal process that the larva attaches itself to the silk threads which it spins on the surface of rocks or plants in the bed of the stream. On the dorsal surface of the last abdominal segment there is a slit-like opening from which the blood gills are projected. (Pl. VI, fig. 6.) These are retractile and vary in form in the different species.

A more extended description of the larva, with a consideration of the uses of the various organs, is given by Johannsen (Bul. 68, N. Y. State Museum, 1903, pp. 345-350), but in the present paper it is only considered necessary to indicate the position of the various organs used in the descriptions.

The larval stage occupies about four to five weeks in summer, but cold weather retards growth, and some species are known to pass the winter in this stage. When full grown the larva spins a cocoon, inside of which it transforms to the pupa. These cocoons are differently shaped in some of the species. In the case of *pictipes* the cocoon somewhat resembles a slipper in shape (Pl. VI, fig. 8), in *venustum* it is more like a conical pocket, while in *hirtipes* it can hardly be called a cocoon, being simply an aggregation of threads, the work of many individuals congregated together on the rock surface, amongst which the larvæ transform to pupæ, and by which they are more or less covered.

PUPA.

The principal character by means of which the pupæ of the different species may be distinguished is the number of respiratory filaments (Pl. IV, figs. 1-6; Pl. VI, figs. 4, 5). These organs are situated on the anterior portion of the thoracic dorsum and consist of from 4 to 60 branches. The number is generally constant in each species, but when there is a very large number of filaments it happens occasionally that there may be a slight variation in numbers in individual specimens. In addition to these respiratory organs as a means of identification, there are situated on the abdomen a number of small hooks on some of the dorsal and also on some of the ventral segments, which serve as a means for the retention of the pupa in its cocoon and which vary in number in the different species.

IMAGO.

In the male the eyes are very large, coming closely together above and leaving no distinct frontal stripe; the upper half has the facets very much larger than the lower, from which they are distinctly divided by a horizontal line. The female has the eyes distinctly separated above, from antennæ to vertex, by a more or less posteriorly divergent-sided frontal stripe, and the eye facets are of almost uniform size, showing more or less tendency to become larger toward the underside in some species. The ocelli are absent in both sexes. The antennæ (Pl. VI, fig. 2) are 11-jointed (various authors have given them as 10-jointed), the basal joint generally short, the second elongated and separated by a more distinct constriction from the third than exists between any of the other joints. the third joint generally subequal in length with the second. The palpi (Pl. V, fig. 9)

are four-jointed. The mouthparts of the female are chitinized and projecting, being adapted for piercing; the male has the mouthparts much more rudimentary.

The thorax is peculiarly formed, and the most remarkable feature about it is the very great development of the scutum and the consequent reduction of the prescutum. The diagram given on Plate I, figure 1, will serve to show this clearly. The presence of such a large membranous field on the pleuræ is also remarkable. The mesonotum has always a surface covering of pilosity, which varies in color and also very much in distribution and in form in the different species. These characters are of considerable importance and are extensively used in this paper. There is a group of hairs situated on the upper portion of the mesopleura between the wing base and the base of the haltere, which is throughout this paper referred to as the *pleural tuft*. Immediately behind the posterior spiracle there is an area which sometimes bears hairs; this I have called the *post-spiracular area*.

The abdomen has been considered as consisting of from seven to nine segments by various authors, and though I have always found eight present there is, besides this number, a loose, scale-like appendage at the base, which most authors consider as the basal abdominal segment. I am not certain of the homology of this part, and while I consider it really abdominal (as against thoracic), I have in this paper consistently referred to it as the *basal scale*, and considered the abdomen as possessing, in addition to this, eight distinct segments. No work has been done with the genitalia in this group and, owing to the nature of these organs, it would require very careful work and plenty of fresh material to make a successful study of them. They are not normally so situated as to be of use in identifications.

The legs are strong, and the tarsi generally well developed, the fore and hind pairs being generally broad and the metatarsi very much elongated. The last three tarsal joints are as shown on Plate V, figure 10. In most species there is an extension at the apex of the hind metatarsus, and in the species with this process there is generally a corresponding modification of the second joint, which is explained in my remarks on the genera. The claws of the male are trifid, of the female simple, bifid, or with subbasal tooth. The wings are very broad and the venation is peculiar, resembling *Scatopse* in some respects. (For venation see Pl. I, figs. 1-4.)

GENERIC SYNONYMY.

The generic name *Simulium* was created by Latreille¹ with one species included. This species, *Rhagio colombaschensis* Fabricius, must be accepted as the type even though Latreille in volume 14 of the same publication (1805, p. 294) indicates that this species, in his

¹ Hist. Nat. Crust. et Ins., vol. 3, 1802, p. 426.

opinion, is synonymous with *reptans* Linnæus. In *Catalogus Dipterorum*, volume 1, 1902, page 288, *colombaschense* Fabricius¹ is given as a synonym of *maculatum* Meigen.² I can not understand the reason for this, unless it be that the name *columbaczense* Schonbauer³ has obtained such currency that there is a disinclination to replace it by a new name, should the slight difference in spelling be accounted insufficient to distinguish the species. Thus it is evident that *Simulium* is a well-authenticated genus.

The resurrection of Meigen's paper of 1800⁴ did, however, temporarily alter conditions, and the suggestion has been made, and acted upon in some cases, that *Melusina* Meigen should supplant *Simulium* Latreille. That I have not accepted this view is due, not to the fact that there were no species included in the genus, but that the first species cited as belonging to it, *Tipulà regelationis* Linnæus,⁵ is that which was given as the type of *Atractocera* Meigen. The placing of this species in *Atractocera* by Meigen was probably based upon a misidentification; still the species, which is now considered as a *Trichocera* Meigen,⁶ must be accepted as the type of *Atractocera* Meigen, and as this genus is given for the first time by Hendel⁷ as synonymous with *Melusina* Meigen, it follows that *Melusina* must be accepted as the generic name of the group to which *regelationis* Linnæus belongs. In other words, both *Atractocera* Meigen and *Trichocera* Meigen must, if we strictly adhere to the rules governing zoological nomenclature, be considered as synonyms of *Melusina* Meigen. Thus I am able, by adhering to the strict letter of the law, to retain the name best known and most generally used for the family. The question of the retention of *Trichocera* Meigen as the generic name for the group containing *regelationis* Linnæus I shall leave to others to decide upon; it is not within the scope of this paper to discuss more than the validity of the names used within the Simuliidæ.

UNRECOGNIZABLE SPECIES AND SYNONYMS.

In practically every family of Diptera there are species which it is impossible to identify from the original descriptions, and in no family is this more apparent, with the possible exception of the Chironomidæ in Great Britain,⁸ than in the Simuliidæ. The species are so similar in general appearance and the tangible characters are so difficult to

¹ Mantissa Ins., vol. 2, 1787, p. 335, No. 15.

² Klass., vol. 1, 1804, p. 95, No. 3, *Atractocera*.

³ Gesch. d. schädli. Kolumb. Mücken, Culex, 1795.

⁴ Nouv. Class. Mouch.

⁵ Illig. Mag., vol. 2, 1803, p. 263.

⁶ Illig. Mag., vol. 2, 1803, p. 262.

⁷ Verhandl. zool.-bot. Ges. in Wien, vol. 58, 1908, p. 50.

⁸ Verrall, in his list of British Diptera, 1901, places 99 of Walker's species of *Chironomus* among the "unrecognizable species."

see, even with a magnification of over 60, that in many cases the describer, failing to note them, has written a description which might serve equally well for several species.

In a case of this kind, where one can not definitely decide which species of several was originally described, there are two courses available, failing the production of the types: Either arbitrarily fix on one of the species, or place the name among the unrecognizable species. Of these courses, the latter has been most generally adopted with Walker's species, and though Coquillett linked up *pecuarum* Riley with *invenustum* Walker, and *vittatum* Zetterstedt with *decorum* Walker, this does not affect the matter of the acceptance of these names, as the first is quite evidently a misidentification of Walker's species and Zetterstedt's name *vittatum* has priority over Walker's *decorum*. *Pecuarum* Riley was described from Louisiana, and the farthest northern record I know for this species is Westville, Conn., while *invenustum* Walker was described from St. Martins Falls, Albany River, Hudson Bay, Canada. The specimens which I have seen from Labrador and which may be either Walker's species or that recorded as *reptans* Linnaeus by Lundbeck,¹ are undoubtedly not *pecuarum*. The only species of Walker's which can be accepted with any degree of certainty is *ochraceum*. In this case the coloration and locality prove good guides, and I believe I am correct in identifying the specimens from Córdoba as belonging to the species Walker had before him when he wrote his description.

I am of the opinion that Coquillett was right in making *argus* Williston a synonym of *vittatum* Zetterstedt, and have followed him in this. *Cinereum* Bellardi I have not seen and I am of the opinion that it will be very difficult, if not impossible, to recognize it. In the case of the species *minutum* Lugger, I believe it is absolutely impossible to recognize what species was intended and have followed Johannsen's synonymy, and the same applies to that author's species *irritatum*. *Pulchrum* Phillipi² I do not consider as identical with *tarsale* Williston, and I reinstate the latter name. *Reptans* Linnaeus I do not believe occurs in America, and I have not included it in my paper. This species is not well defined even in Europe, and I have been unable to identify any American specimens with either of the two species I obtained as *reptans* from Britain, either or neither of which may be the true *reptans*.

Surcouf and Gonzales-Rincones³ have proposed the specific name *minutum* for the species described by Dr. Lutz as *exiguum*,⁴ which name is preoccupied by *exiguum* Roubaud.⁵ The specific name *minu-*

¹ *Diptera groenlandica*, 1898.

² *Aufzählung der chilenischen Dipteren*, 1865, p. 633.

³ *Diptères vulnérantes*, vol. 1, 1911, p. 290.

⁴ *Memoirs d. Instituto Cruz*, vol. 1, part 2, 1909, p. 141.

⁵ *Bull. Mus. Paris*, 1906, p. 109.

tum is also preoccupied by a species recorded by Lugger,¹ and I propose for this species the name *lutzi*.²

TABLE OF GENERA.

- | | |
|---|-----------------------------|
| 1. Basal joint of hind tarsus generally distinctly prolonged, lappet-like, on posterior surface at apex; second joint with basal scale-like process and dorsal excision; radial vein unforked; basal cell absent..... | <i>Simulium</i> , p. 25. |
| Basal joint of hind tarsus generally but little produced at apex posteriorly; second joint linear, without basal scale or dorsal excision; radial vein generally with elongate fork..... | 2 |
| 2. Face broad; basal cell of wings distinct..... | <i>Prosimulium</i> , p. 15. |
| dorsal excision; radial vein unforked; basal cell absent..... | <i>Simulium</i> , p. 25. |

TABLE OF LARVÆ.

The following table of larvæ has been arranged to include all the species dealt with in this paper which have been associated with the adults.

- | | |
|--|--------------------------------|
| 1. Labium with the central tooth trifid..... | 2 |
| Labium with the central tooth simple..... | 3 |
| 2. Only the central labial tooth trifid..... | <i>P. pecuarum</i> , p. 23. |
| All teeth except the outer one on each side more or less irregularly trifid..... | <i>P. hirtipes</i> , p. 19. |
| 3. Anal blood gills simple, three in number..... | <i>S. vittatum</i> , p. 55. |
| Anal blood gills subdivided..... | 4 |
| 4. Large species (10-12 mm. in length), almost black in color. | <i>S. pictipes</i> , p. 57. |
| Smaller larvæ, generally yellowish in color, with more or less distinct cross-bands to segments..... | 5 |
| 5. Last joint of maxillary palpus without setæ..... | <i>S. meridionale</i> , p. 51. |
| Last joint of maxillary palpus with setæ..... | 6 |
| 6. Labium with seven pairs of setæ on ventral surface..... | <i>S. piscicidium</i> , p. 46. |
| Labium with less than seven pairs of setæ..... | 7 |
| 7. Labium with four pairs of setæ..... | <i>S. jenningsi</i> , p. 42. |
| Labium with five pairs of setæ..... | <i>S. venustum</i> , p. 44. |

The foregoing table is partly constructed from that given by Johannsen in his paper on the group. It is probable that there are groups, instead of single species, with the characters given in this table and in the table for the pupæ (p. 15), but until some one with the necessary knowledge of the anatomy of the larvæ and pupæ devotes considerable time to their study our knowledge must remain fragmentary and unsatisfactory. It is also probable that there are some species which are not possessed of tangible distinctions in the imago stage which may be easily separated in either the larval or pupal stage.

¹ Bul. 48 Minn. Agr. Exp. Sta., 1896, p. 202.

² The manuscript of this paper was completed in December, 1912, but has been delayed in its appearance in print from various causes. In the number of "Insector Inscitiae Menstruus" for December, 1913, there appears a note on American Simuliidæ, which deals with certain matters referred to in this and preceding pages. The writer of the note referred to was cognizant of the existence of this manuscript, and conversant with its contents, which I consider do not accordingly require any alteration due to the appearance of said note.

TABLE OF PUPÆ.

The table of pupæ which follows is arranged to include only the North American species associated in this stage with adults.

1.	Respiratory filaments 4 in number-----	<i>S. bracteatum</i> , p. 39.
		<i>S. johannseni</i> , p. 66.
	Respiratory filaments more than 4 in number-----	2
2.	Respiratory filaments 6 in number-----	3
	Respiratory filaments more than 6 in number.	
3.	Each of the three main filaments divided close to base--	<i>S. meridionale</i> , p. 66.
	Each of the three main filaments divided at some distance from base,	
		<i>S. venustum</i> , p. 44.
4.	Respiratory filaments 8 in number-----	5
	Respiratory filaments more than 8 in number-----	6
5.	Filaments in pairs-----	<i>S. piscicidium</i> , p. 46.
	Filaments not in pairs (Pl. VI, fig. 4)-----	<i>S. metallicum</i> , p. 49.
6.	Respiratory filaments 9 in number-----	<i>S. pictipes</i> , p. 57.
	Respiratory filaments 10 or more in number-----	7
7.	Respiratory filaments 10 in number-----	<i>S. jenningsi</i> , p. 42.
	Respiratory filaments more than 10 in number-----	8
8.	Respiratory filaments 16 in number-----	<i>S. vittatum</i> , p. 55.
	Respiratory filaments at least 22 in number-----	9
9.	Respiratory filaments 22 to 25 in number-----	<i>S. forbesi</i> , p. 65.
	Respiratory filaments generally more than 40 in number-----	10
10.	Respiratory filaments at most 48 in number-----	<i>P. pecuarum</i> , p. 23.
	Respiratory filaments generally 60 or more in number----	<i>P. hirtipes</i> , p. 20.

In addition to the species included in the above table there are two species described in this stage which have not been linked up with the imago. One of these, from Arizona,¹ has 8 filaments, and the other, from Santa Cruz Mountains,² has 12. It may be that these species are described in the imago stage and have not yet been associated with the pupæ.

Since the completion of the manuscript of this paper I have had the opportunity of working over the material in the collection of the Illinois State laboratory of natural history which has resulted in the addition of *forbesi* to the list of species.

PROSIMULIUM Roubaud.

Prosimulium was originally proposed as a subgenus by Roubaud.³ The characters which he used for the separation of the group from *Simulium* Latreille were those of the hind tarsus and also the formation of the cocoons, which he considered as possessing a generic value from the fact that they are incomplete, a mere shapeless mass of threads, whereas in *Simulium* the cocoons in the known species are slipper-shaped and separately formed. It may be that his

¹ Trans. Amer. Ent. Soc., 1893, p. 45.

² Bul. 68, N. Y. State Mus., 1903, p. 387.

³ Compt. Rendus Acad. Sci., Paris, 1906, p. 519.

deductions are correct with regard to the formation of the cocoons of this genus, but on the other hand some of the species which are unknown in the early stages may have habits similar to *Simulium* Latreille, and I therefore do not make use of them, preferring to use the characters furnished by the venation of the wings,¹ which was not mentioned by Roubaud in dealing with the group, as well as those of the hind tarsus.

As I have already pointed out, in dealing with the larval characters, it is not improbable that the labium of the larvæ may provide a further character for the separation of this genus from *Simulium*, though that, like the character of the cocoon formation, requires further study before being accepted as a generic rather than a specific character.

Roubaud states that the claws in *Prosimulium* are all of one type, "very simple," and also that the species are confined to "high altitudes or cold regions." These statements are not in accordance with the actual facts of the case, as he included *pecuarum* Riley, which has bifid claws, and was originally described from Louisiana, as one of the species in his original definition of *Prosimulium*. It is always risky to generalize upon insufficient data or material, and though I possess probably a much larger amount of material than Roubaud had, I consider that I have gone as far as my material justifies me in separating the genera by the characters given in my table and in indicating the probable significance of others without giving them as generic distinctions.

GENERIC CHARACTERS.

Eyes in male large, meeting above, the upper facets much larger than the lower and separated by a horizontal line; in female the eyes are separated by a wide and more or less divergent-sided stripe. Antennæ 11-jointed; palpi 4-jointed. Wings with the radial vein furcate, or indistinctly so, or simple (*mutatum*), and a small, closed cell near wing base (Pl. I, fig. 3). Hind tarsi with apex of first joint very slightly produced posteriorly, except in *mutatum*, and second joint linear (Pl. II, figs. 1, 2); tarsal claws tridentate in male, in female simple (Pl. II, fig. 13), or with the base produced thumblike (Pl. II, figs. 14, 16).

Type of genus.—*Simulium hirtipes* Fries.

TABLE OF SPECIES.

1. Eyes widely separated above (females)-----	2
Eyes closely coherent above (males)-----	6
2. Tarsal claws with base produced into an elongated projection, bifid----	3
Tarsal claws with base only slightly tuberculate or rounded, simple----	4

¹ I have included in this genus *mutatum*, which has the radius simple, and *pecuarum*, which has it very indistinctly furcate, preferring to retain the former here instead of erecting another genus for it.

3. Furcation of radial vein very short and ill-defined; mesopleuræ bare.....*pecuarum*, p. 21.
 Furcation of radial vein distinct and elongate; mesopleuræ with distinct hairs.....*pleurale*, p. 17.
4. Yellow species.....*fulvum*, p. 18.
 Black species with gray or yellow legs..... 5
5. Fork of radius long and distinct.....*hirtipes*, p. 18.
 Radius unforked.....*mutatum*, p. 20.
6. Entirely yellow species.....*fulvum*, p. 18.
 Black species..... 7
7. Fork of radial vein very short, indistinct.....*pecuarum*, p. 21.
 Fork of radial vein long and distinct.....*hirtipes*, p. 18.

Prosimulium pleurale, new species.

Female.—Black-gray, opaque. Frons and face whitish-dusted, antennæ brown-black, palpi concolorous. Mesonotum without stripes or distinct pollinose spots; pleuræ, scutellum, and postscutum concolorous with disk of scutum. Abdomen opaque, black-gray. Legs brownish-yellow; all tarsi, and especially fore pair, and apices of tibiæ darkened. Wings grayish, veins brown, thin veins rather more distinct than usual. Halteres brownish-yellow.

Frons divergent-sided, at vertex twice as wide as at above antennæ, surface thickly covered with long, soft, white hairs; face as long as frons and distinctly longer than broad, colored as frons and similarly haired; antennal pile white, hairs on palpi brown, postocular cilia pale, some longer brown hairs present near eye margins. Mesonotum with long, loose, hairlike, white pilosity, which is longer on the anterior lateral angles and posteriorly; a few longer, dark, upright hairs on posterior fourth; pleural tuft white, extending almost to the lower angle of the epimerum; another group of similarly colored hairs occupying the lower portion of episternum (*eps*₂); postspiracular area pale-haired; scutellum with long, white, upright hairs and decumbent white pilosity. Abdominal basal scale brownish-yellow, the fringe whitish, sides of all segments with long, silky, white hairs, disk with much shorter brown hairs. Legs long, with white hairs and shorter white pilosity; hind tarsi with basal two joints of the usual form in this genus; claws bifid (Pl. II, fig. 16). Wings with costal divisions beyond subcostal vein $2:\frac{3}{4}:1\frac{1}{4}$; veins fine and short-haired; basal wing hairs short, brown.

Length, 4 mm.

Type.—Cat. No. 15403, U. S. National Museum. One female, Kaslo, British Columbia (R. P. Currie).

The early stages are unknown. The situation of the anterior pleural hairs, bifid claws, and furcate radius should readily distinguish this species from any other.

Prosimulium fulvum Coquillett.

Female.—Entirely yellow or ochereous; the antennæ except basal three joints, the pleuræ, abdomen, and tarsi more or less brownish. Wings yellowish, the veins distinct. Halteres yellow.

Frons rather strongly divergent, at lower angle of eyes about two-fifths as broad as at upper angle; surface hairs long and numerous, golden yellow in color; face slightly broader than frons at lower angle and rather longer than broad, haired as frons; palpi brown-haired; postocular cilia long, yellow, with a strong admixture of black hairs. Mesonotum with longish, yellow, hairlike pilosity, rather shaggy on anterior, lateral, and especially on posterior margins; pleural tuft yellow, continued downward more than midway to coxæ; scutellum with long yellow pilosity, and shaggy, upright, yellow hairs. Abdomen with yellow basal fringe, and numerous short yellow surface hairs. Legs with long yellow hairs, among which are a few dark ones, the tarsal hairs brownish; tarsal claws simple (Pl. II, fig. 13). Wings with surface hairs yellow, the small cell at base of upper fork of cubitus distinct.

Length, 4–5 mm.

There are females in the collection from Sitka, Virgins Bay, and Kukak Bay, Alaska; from Bear Lake, Kokanee Mountains, Kaslo, South Fork, Lowes Inlet, and Laggan, British Columbia, and Custer County, Colo.

Male.—Similar in size and color to the female, but with much longer hairs, especially those forming the fringe to the basal scale, those on surface of abdomen, and those on the legs. The fore tarsus is slender, and the basal joint of hind tarsus is much dilated, being as broad as the apical portion of hind tibia (Pl. II, fig. 1); the claws are trifid.

The type specimen (Cat. No. 6182, U. S. National Museum) is from Bear Paw Mountain, Mont., September 3, 1895 (Hubbard).

Nothing is known of the life history, or details of the early stages of this species, and there are no records of whether or not it bites either man or animals.

Prosimulium hirtipes Fries.

Female.—Black, opaque. Antennæ with two basal joints pale yellowish-brown. Scutum unstriped, and without any distinct anterior pollinose spots; prescutum and pleuræ sometimes brownish. Abdomen with basal scale brownish; sometimes the segments appear faintly whitish-dusted on posterior margins. Legs brown; coxæ, knees, tips of tibiæ and tarsi, especially fore tarsus, darker. Wings grayish. Halteres brown.

Frons divergent-sided, occupying less than one-third the width of head at upper angle of eyes, and two-thirds as wide above antennæ as at upper angle, surface covered with close-placed, yellow, hair-like pilosity; face slightly narrower than frons at upper angle and distinctly longer than broad, haired as frons; palpi pale-haired, postocular cilia pale. Scutum covered with very closely placed yellow pilosity, which is much longer and upright on posterior fourth, no black hairs present; pleural tuft pale yellow, carried almost to lower margin; scutellum with decumbent yellow pilosity, and long, upright, yellow hairs. Abdominal basal fringe yellow, all segments covered with moderately closely placed, yellow, hairlike pilosity. Legs with yellow pilosity, and similarly colored upright dorsal hairs; fore tarsi slender, joints without apical paired hairs; claws simple. Fork of radius distinct, group of hairs at base of first thick vein yellow; beyond this the hairs on surfaces of veins are brown.

Length, 3.5–4.5 mm.

Localities of specimens examined: Ithaca, N. Y. (O. A. Johannsen); Wellesley, Mount Tom, and Cohasset, Mass.; Cape Charles, Newfoundland; Morristown and Germantown, Pa.; Kingston, R. I.; Rigolet, Labrador; and Moscow, Idaho (collection C. W. Johnson); Cabin John, Md. (J. R. Malloch); White Mountains, N. H. (Morrison); Mount Katahdin, Me.; Williams, Ariz. (H. S. Barber); Kaslo and Laggan, British Columbia (Dyar and Caudell); Plummers Island, Md. (W. L. McAtee). The dates of capture are for the Eastern States confined to the latter part of April and larger part of May; the specimen from Arizona was taken on June 3. The specimens from British Columbia bear the dates July and August, one from Maine (3,000 feet level) August, and the Newfoundland and Labrador specimens were taken in July. In the collection of the Illinois State Laboratory of Natural History there are two females of this species from Algonquin, Ill., one of which bears the date April 29, 1895 (Nason).

Male.—Similar in color and size to the female, but as a rule there is less tendency to have the base of the antennæ and portions of the legs pale. The hairs and pilosity are much darker, being uniformly brown, or yellowish brown, and much longer, especially the basal fringe on abdomen. The hind legs are much more dilated, especially the basal tarsal joint, and the claws are trifid.

There is no indication of pollinosity on thorax or abdomen in any specimen I have examined.

Larva.—Yellowish brown in color; antennæ as in Plate VI, figure 3, mandibles with the apical teeth black, the smaller ones yellowish; labium with the teeth mostly trifid (Pl. III, fig. 3). The maxilla of the larva is shown in Plate III, figure 6. This is the largest species yet

found in this stage in America. It occurs in the early months of the year—is stated by some observers to hibernate in this stage—and pupates at the end of April, the imago emerging in about 10 days after pupation takes place.

Pupa.—This species may be known in the pupal stage by the very large number of respiratory filaments (Pl. IV, fig. 5). These number as high as 60 in some cases, but as is generally the case where there is a multiplicity of branches there is a greater tendency to variation in number than with the species which have only a few filaments. No distinct cocoon is formed by this species.

This fly is reported to be a very persistent biter and does not confine its attentions to cattle, but attacks human beings as well.

I have only one poorly preserved European specimen of *hirtipes* before me and can not find any characters to separate it from the American species. They may be identical, but only a knowledge of the early stages of both can definitely decide this.

The species figured in Bulletin 159,¹ Kentucky Agricultural Experiment Station, is quite evidently *hirtipes* and not *pecuarum* Riley.

There are several specimens in collections from the White Mountains and also some from British Columbia which have the legs yellow. These may belong to a different species, but I can not find any distinguishing characters in the specimens other than this, which I consider is too prone to variation to prove reliable.

Prosimulium mutatum, new species.

Female.—Black-gray, subopaque. Only the prescutum, posterior portions of pleuræ, and legs more or less yellowish. Mesonotum without distinct pollinosity, and unstriped. Wings grayish, veins brown. Halteres brown.

Frons gray-dusted, narrow, slightly divergent-sided, occupying about one-fifth the width of head at upper angle of eyes, a distinct, central, longitudinal depression over antennæ, surface hairs pale, sparse; face colored as is frons, a little longer than wide, and as wide as frons at upper angle, surface hairs pale; antennæ with the basal joints not distinctly paler than remainder; hairs on palpi dark; proboscis short; postocular cilia pale, with a few longer black hairs intermixed. Mesonotum with sparse, rather widely separated, yellow, hair-like pilosity; posterior fourth of scutum with a few upright black hairs; pleural tuft pale, long, confined to upper fourth; scutellum with pale upright pilosity and upright brown hairs. Abdomen with pale basal fringe, and scattered pale surface hairs, which are more numerous on lateral margins and apical segments. Legs with pale pilosity and dark, longer, upright dorsal hairs; fore tarsi

¹ Bul. 159, Ky. Agr. Exp. Sta., fig. 4, p. 18; fig. 5, p. 20; fig. 6, p. 21, 1912.

slender, without paired apical hairs; fore tibiæ with weak apical spur; hind tarsi with basal joint distinctly produced at apex (Pl. II, fig. 18), second joint without scale but slightly constricted dorsally at base; tarsal claws simple. Wings without fork to radius, the small closed basal cell present; hairs on wing veins brownish black.

Length, 3-4 mm.

Type.—Cat. No. 15404, U. S. National Museum.

Type locality, Glassboro, N. J., March 28, 1910 (C. T. Greene). Paratypes from Clementon, N. J., May 7, 1910 (C. T. Greene); St. Louis, Mo., April 6, 1904 (W. V. Warner); Kaslo, British Columbia (H. G. Dyar); Mount Rainier, Wash. (M. W. Lyon, jr.); Sitka, Virgins Bay, and Yakutat, Alaska, Harriman Alaska Expedition (T. Kincaid); Metlakatla, Alaska. There is a specimen of this species in the Illinois State Laboratory of Natural History collection from Homer, Ill., April 25, 1909.

This species presents some characters which differ considerably from those of the type of the genus (*hirtipes*), but I do not consider it necessary to create a new genus for its reception, more particularly because at least one character, and the most pronounced, the radial furcation, is only indicated to a slight extent in *pecuarum*, which is clearly congeneric with *hirtipes*. Roubaud in subdividing *Simulium* used the tarsal characters and did not cite the types of his genera. His *Eusimulium* is clearly a synonym of *Simulium*, as the characters indicated for its separation from *Prosimulium* are those possessed by the type of that genus, and the only species mentioned by Roubaud as an example of *Eusimulium* is *aureum* Fries, which possesses the tarsal characters given by him. He evidently considered it inadvisable to use *Simulium* as the name of one of his divisions, because he intended only to make use of these as subgenera, and not genera. Surcouf and Gonzalez-Rincones¹ have, however, used the three names and placed in the genus *Eusimulium*, which they characterize as having the "second hind tarsal joint constricted," a number of species which they evidently knew only from the printed descriptions. In *Simulium sens. strict.* they include several species which they evidently have never had an opportunity of examining, and which certainly possess the same tarsal characters as those they relegate to *Eusimulium*. I have considered Roubaud's genus as a synonym of *Simulium* and also consider that the publication above referred to does not materially affect this position.²

Prosimulium pecuarum Riley.

This species is similar in color and size to *mutatum*, but differs as follows: The pilosity on scutum and hairs on abdomen are whitish-yellow, the scutum is more or less distinctly three-striped, the hind

¹ Diptères vulérants des du Venezuela, I, 1912, p. 276.

² See footnote 3 to p. 14.

tarsus has the basal joint but little produced at apex (Pl. II, fig. 2), the claws are bifid (Pl. II, fig. 14), and the radius is very indistinctly furcate at apex.

The species was originally described from reared specimens, the larvæ and pupæ of which were stated to have been obtained at Frier-sons Mill, La., but the type specimen in collection is from a lot obtained by Prof. F. M. Webster at Somerset Landing, La., April 10, 1886. A very large number of these specimens are in the collection. There is also a series of specimens from Lake View, Miss., April 18, 1886; one specimen, College Station, Tex., (F. M. Webster); four specimens, Arkansas, May 6, 1886 (Lugger), and I have seen specimens from Westville, Conn., April 25, 1907 (W. E. Britton), and Iona, N. J., April 21, 1907 (collection C. W. Johnson), which agree with the types, except in being rather darker in color. There are several females of this species in the Illinois State Laboratory of Natural History collection from Aledo, Ill., April 30, 1891, 1 female from Quiver Lake near Havana on the Illinois River, April 30, 1895, and 1 female from Havana, Illinois River, April 14, 1896. The record of *Simulium vittatum* from Mount Carmel, Ill., April 9, in the Twenty-seventh Report of the State Entomologist of Illinois, 1912, page 37, refers to *pecuarum*.

The male specimens from which Riley's description was drawn are not among the material in the collection, and those mentioned as being in Cornell University Museum, by Johannsen, I have found upon examination are females. Thus, I have had to copy the original description.

♂.—Length 1.5^{mm}. to 2.2^{mm}. Differs considerably from female. *Head* not visible from above, being occupied by the very large confluent eyes; the remaining parts below the eyes are black, with black hairs and bristles; eyes composed of two different kinds of facets, those above being very large, as large again as those of the female, and those in front and surrounding the dwarfed trophi very minute, the dividing line between the sizes being abrupt; antennæ similar to those of the female, more pronounced in color, both the black and reddish being more vivid; maxillary palpi black, and shorter than the antennæ. *Thorax* black above, with sparse yellow hairs; legs somewhat lighter in color, tip of tarsi not black; hairs upon legs longer than in those of female. *Wings* hyaline, veins and base yellowish-brown. *Abdomen* black, with grayish-white posterior margins to segments, dorsally and laterally, and covered with longer yellowish hairs.

Described from two bred specimens.

This species is known popularly as the "buffalo-gnat," and has in the past proven a great pest to cattle in the South, particularly near to the Mississippi and Ohio Rivers. Very few recent specimens are in the collection and the general opinion among entomologists seems to be that it is much less common than in former years, when it is recorded as having been so numerous and so persistent in its attacks on stock as to kill mules and cattle.

Riley's description of larva, pupa, and cocoon follows:

Larva.—Average length when full grown, 7 mm. to 8 mm., subcylindric, the club-shaped posterior third of body being twice as stout as the thoracic joints, and joint 4 the most constricted. Translucent when living, dirty white in alcohol. Immaculate in a very few specimens; distinctly marked in the great majority with brownish dorsal cross-bands in middle of joints, leaving free a white mediodorsal longitudinal line; thoracic joints with three irregular rings of the same color; underside more or less irregularly spotted with brown. *Head* subquadrate, horny, yellowish-brown, with a number of brown spots and lines in regular order as in figure, and two roundish, approximate ocellate black dots on each side under the skin, and seemingly rudimentary organs of sight, from which the future compound eyes originate: *antennæ* uniformly pale, three-jointed, about one-third as long as greatest width of head; joint 1 very stout, fully four times as thick as 2, which is a little longer than 1, straight, slightly tapering towards tip; joint 3 extremely small, a mere triangular tip: *mentum* [labium] subtriangular, with apex cut away and replaced by three groups of very small teeth, of which the central group consists of three teeth, the middle one largest, and the groups on side, of four teeth, of which the second from center is largest; sides of *mentum* [labium], near apex, with two small teeth each; all the teeth are chitinous and black; a long erect bristle, pointing upward and inward, near each side of *mentum*: *labrum* horny, densely covered with hair: *mandibles* resembling in shape the profile of the inverted last joint of the human thumb, with a series of teeth in place of the nail; teeth difficult to see, owing to the presence of five distinct brushes of hair; on extreme lower tip of *mandibles* three large teeth, below them a series of eleven slender and very pointed teeth, of which the first two are the smallest, teeth 3 to 9 increasing and teeth 10 and 11 gradually decreasing in length; a second series of teeth below them consists of two triangular teeth, of which the first is largest: *maxilla* stout, fleshy, with an internal thumb-shaped lobe; *maxillary palpus* two-jointed, first joint cylindric, second very short, crowned with a regular circular row of short spines or warts: *labium* [hypopharynx] horny, with two brushes of hair above, between which is a very small *ligula*, covered with a small brush of hairs; *fans* composed of a stout stem, bearing about forty-six scythe-shaped rays, lined on the inside by very minute, equidistant, erect hairs of equal length. *Thoracic proleg* faintly four-jointed, subconical, retractile (introversible), very thin and transparent, crowned with about twenty rows of short, sharp hooks, apparently arranged in a circular manner; the hooks, of which ten are in each row, seem to be movable to a certain extent, and are fastened or hinged to small chitinous rods in the epidermis. *Tip of abdomen* formed by a subcylindrical body crowned with rows of hooks. *Breathing organs* below these hooks and on the upper side of abdomen; they consist of three short, cylindrical, soft and retractile tentacles, which connect with the large internal tracheæ. In full-grown larvæ a spot more or less dark is seen on each side of thoracic joint; it is produced by the formation of the coiled breathing tubes of the future pupa.

Pupa.—Average length 5 mm. General color, when fresh, honey yellow; prothoracic filaments brown, and the abdomen dorsally also tinged with brown, except on mediodorsal space; all the members have also a fine brown marginal line. Prothoracic filaments consisting of six main rays, issuing from the basal prominence and subdivided two or three times, so that in most cases as many as forty-eight terminal filaments can be counted. [Pl. IV, fig. 1.] Abdominal joints 3, 4, and 5 each with eight well separated dark-brown and anteriorly-recurved hooks, the four on each side separated by a mediodorsal space; those on joint 3

less conspicuous than those on joints 4 and 5; joint 6 with armature; joints 7, 8, 9, and also subjoint [anal] less distinctly armed near anterior margin with a continuous dorsal row of very minute posteriorly recurved points; ventrally joints 6, 7, and 8 have each four very minute anteriorly recurved hooks.

Cocoon.—Average length 3.5 mm. Not completely made and not entirely covering the pupa, but tightly surrounding its larger portion. Shape very irregular, with no distinct rim at the upper edge, which is more or less ragged. The threads composing it are very coarse, and the meshes rather open and ordinarily filled with mud. Not always fastened separately to objects, but frequently crowded together, without forming, however, such coral-like aggregations as in some of the Northern species.

The species figured by Garman as the "buffalo-gnat" (*S. peculiarum* Riley) in Bulletin No. 159 of the Kentucky Agricultural Experiment Station, 1912, page 18, is not this species but *hirtipes* Fries.

NOTE.—Unfortunately the bulk of the material in the collection is practically all from two localities and there are no males in either lot. Prof. F. M. Webster's material, which included males, collected subsequent to the date on the type lot, from the following localities: Madison and Vinland, Ark.; Cypress Mill, Marble Falls, and Devils River, Tex.; and Wooster, Ohio, can not be found.

PARASIMULIUM, new genus.

This genus differs in the female from *Prosimulium* Roubaud in having the eyes much more widely separated at vertex, in having the frons much higher than highest level of eyes when viewed from the side, in having the face linear, in having the eye facets gradually enlarged as they descend, and in the absence of the closed cell in the wing (see Pl. I, fig. 4).

The male is unknown.

Type of genus.—*Parasimulium furcatum*, new species.

Parasimulium furcatum, new species.

Female.—Black-brown, shining. Frons shining black, undusted; face black; antennæ with second joint black, remaining joints yellow; palpi black. Mesonotum shining black-brown, paler posteriorly; prescutum pale yellowish-brown; pleuræ brown. Abdomen brown, anal organs yellow. Legs pale yellow. Wings grayish, all veins brownish, base of wing very pale yellowish-white. Halteres with brown knob and yellow stalk.

Frons very broad, widely divergent posteriorly, clothed with long, close-lying, yellow-white hairs; face very narrow, linear, raised ridge-like centrally, surface brown-haired; antennæ inserted at above half the height of eyes, the basal joint very short and indistinct, the second joint large, third joint slightly longer than second, and as long as fourth and fifth together, fourth longer than fifth, fifth to tenth subequal, eleventh longer than tenth, pilosity pale, very short. Scutum covered with close-lying yellow hairs except on posterior third where it narrows and has only scattered, longer, upright hairs

on the surface; prescutum with upright, rather strong, brownish hairs; pleural tuft indistinct; scutellum with pale brown, upright hairs on posterior margin; postscutum produced. Basal abdominal scale yellowish-brown, fringe white, abdominal segments with scattered pale hairs. Legs with weak pale hairs; no distinct apical tibial spurs; hind tarsi as in *Prosimulium*, tarsal bristles very weak; claws short and stout, simple. Wings with long hairs on thick veins, venation as in Plate I, figure 4.

Length, 1.25 mm.

Type.—Cat. No. 15405, U. S. National Museum.

One female, Bairs Ranch, Redwood Creek, Humboldt County, Cal. (H. S. Barber).

Nothing is known of the early stages of this species.

SIMULIUM Latreille.

TABLES OF MALES.

As most of the species are known in the female sex only, it is not possible to include all the species described from North America in this table.

- | | |
|---|-----------------------------|
| 1. Species with noticeable yellow marks on abdomen or thorax..... | 2 |
| Species mostly black, only the legs and antennæ with yellow markings..... | 3 |
| 2. Small species, 1 mm., mostly yellow colored; scutum indistinctly striped..... | <i>notatum</i> , p. 33. |
| Larger species, 1.5 to 2 mm., mostly black colored; scutum distinctly striped..... | <i>distinctum</i> , p. 30. |
| 3. Legs with basal joint of hind tarsus not bicolored..... | 4 |
| Legs with basal joint of hind tarsus bicolored..... | 5 |
| 4. Pilosity of scutum whitish..... | <i>a</i> |
| Pilosity of scutum golden yellow, or brassy..... | <i>b</i> |
| <i>a</i> . Scutum unstriped; dorsal excision and scale on second joint of hind tarsus indistinct..... | <i>meridionale</i> , p. 49. |
| Scutum with black stripes as in female, the outer one on each side curved; second joint of hind tarsus with distinct scale..... | <i>johannseni</i> , p. 65. |
| <i>b</i> . Pilosity of scutum and abdomen brassy, scale-like..... | <i>bracteatum</i> , p. 38. |
| Pilosity of scutum yellow, hairlike, especially hairlike on abdomen..... | <i>forbesi</i> , p. 64. |
| 5. Small species (not more than 2 mm. in length); mid tarsus mostly yellow..... | 6 |
| Larger species (at least 2 mm. in length); mid tarsus with at most bases of first and second joints pale. | |
| 6. Scutum almost entirely covered with pearlaceous pollinosity; one distinct, opaque black, central stripe present..... | <i>griseum</i> , p. 53. |
| Scutum with two anterior pearlaceous, posteriorly incurved, elongate spots, disk velvety black..... | <i>jenningsi</i> , p. 42. |
| 7. Scutum with distinct stripes..... | 8 |
| Scutum with at most two posteriorly incurved spots on anterior margin..... | 10 |

8. Stripes on scutum curved, the outward extremities of dorso-lateral pair dilated; legs with a narrow black or brown ring or spot near base of tibiae in addition to the usual dark marks present on the legs in most species-----*virgatum*, p. 58.
 Stripes on scutum straight, legs with the bases of tibiae pale, and without a subbasal dark band----- 9
9. Stripes on scutum not sharply defined, the central black stripe broad at anterior extremity, linear on disk, the outer black stripes short and narrow-----*glaucum*, p. 60.
 Stripes on scutum generally sharply defined, the black always broader than the white stripes-----*vittatum*, p. 54.
10. Only two posteriorly incurved, elongate spots on anterior margin; fore tarsus distinctly dilated-----*venustum*, p. 44.
 In addition to the two spots just mentioned, there are sometimes present two smaller spots on the anterior margin nearer to center and occasionally also faint indications of a central bifid stripe; fore tarsus very slightly dilated-----*pictipes*, p. 56.

I have not seen the males of *Simulium metallicum* Bellardi, *S. cinereum* Bellardi, nor *S. mexicanum* Bellardi, but translations of the original descriptions are given under the descriptions of these species.

SPECIES GROUPS IN SIMULIUM LATREILLE (FEMALES).

1. Mesopleura with a group of hairs in addition, and anterior to the normal pleural tuft-----Group A, p. 26.
 Mesopleura bare except for the pleural tuft----- 2
2. Yellow species; scutum with brown, or white longitudinal stripes, or two discal elongated spots; abdomen and legs with black or brown marks-----Group B, p. 29.
 Black or gray species, scutum and abdomen never yellow (cf. *griseum*)----- 3
3. Scutum with three, or five stripes, or only one central stripe, either black or brown on a gray ground, or metallescent pollinose on a black ground, the dorso-lateral pair, when present, distinctly curved, and dilated at anterior extremities-----Group D, p. 47.
 Scutum with two, or four broad, white, straight, or very slightly curved stripes, which are nearly parallel-sided and not noticeably dilated at anterior extremities, or scutum unstriped----- 4
4. Scutum unstriped or with only very slight indications of a central, darker, divided stripe-----Group C, p. 34.
 Scutum distinctly striped, the stripes white or metallescent pollinose-----Group E, p. 61.

It is not the intention of the writer to indicate from the above arrangement that these groups are entitled to treatment as subgenera; the purpose in separating them thus is merely to facilitate the work of identification of the species.

GROUP A.

Species with hairs on pleurae in addition to and anterior to the pleural tuft.

TABLE OF SPECIES.

1. Claws with minute subbasal tooth; thoracic pilosity golden yellow, irregularly arranged in small groups; mesopleural hairs situated low down-----*aureopunctatum*, p. 27.

Claws simple; thoracic pilosity not arranged in groups, regularly disposed; mesopleural hairs high up near to margin of scutum.

hippovororum, p. 28.

I have seen very few species of Simuliidæ with the additional pleural hairs, but one of those I have obtained as *reptans* Linnæus, from Britain, another in the collection labeled *S. lineatum* Meigen, variety, and also *subnigrum* Lutz, are in this category, though no one who has previously described any species in the family has ever indicated that he has noticed the presence of these hairs or scales.

Simulium aureopunctatum, new species.

Female.—Black, subopaque. Frons and face with whitish dusting; antennæ brown, two basal joints yellow, palpi black. Scutum unstriped, slightly whitish-dusted anteriorly, but without distinct white spots; prescutum and margin of scutum close to it yellowish; pleuræ black-brown, scutellum and postscutum concolorous with scutum. Abdomen black-brown, basal four segments subopaque, apical four shining. Legs yellow, blackened as follows: Entire ventral surface and apical half of dorsal surface of tibiæ, and entire tarsi of fore pair; coxæ, femora except bases, apical halves of tibiæ, apex of first, apical half of second joint, and apical three joints of tarsi of mid and hind pairs. Dorsal surfaces of all tibiæ with distinct silvering. Wings clear, slightly grayish at tip and on hind margin, thick veins brown. Halteres brownish yellow, stalk darker.

Frons divergent-sided, not one-third as wide at upper angle of eyes as width of head, distinctly narrower above antennæ than at upper angle, surface hairs black, strong but not numerous; face slightly convex, distinctly longer than broad, and slightly broader than frons at upper angle, surface hairs black, on upper portion short and sparse, longer on lowest fourth; palpi black-haired, post-ocular cilia brown. Scutum with yellow scale-like pilosity which adheres closely to the surface and is arranged in irregular groups of from three to seven scales of uniform length except on posterior fourth where they become longer and are more upright; besides this pilosity the surface bears numerous short, upright, black hairs which are most conspicuous on anterior, lateral, and posterior margins; pleural tuft brown, the anterior pleural hairs golden yellow, scale-like, situated about midway from lower to upper margin on mesopleuræ; postspiracular area haired posteriorly; scutellum with yellow scale-like pilosity and several long, upright, blackish hairs on posterior margin. Basal fringe of abdomen long, yellow, surface hairs on seg-

ments short, black-brown. Legs strong; fore tarsi compressed laterally, basal joint as broad as tibia, joints 1-3 with paired apical hairs; all legs with pale pilosity and longer, upright, black dorsal hairs; apical spur absent from fore tibiae, hind and mid pairs with paired apical spurs; basal joint of hind tarsi as broad as tibiae, produced apically on posterior surface, claws as in *virgatum* (Pl. II, fig. 11). Wings with outer two thick veins joining costa very close together so that the last costal division is very indistinct.

Length, 3-3.5 mm.

Type and paratypes.—Cat. No. 15406, U. S. National Museum.

Localities: Livingston, Guatemala, and Cacao, Trece Aguas, Alta Vera Paz, Guatemala, April-May (Barber and Schwarz).

Nothing is known of the early stages of this species.

Simulium hippovorum, new species.

Female.—Black, subopaque. Frons and face brownish, thickly covered with white pollinosity; antennae brown, basal two joints and base of third joint yellow; palpi brown. Scutum with three stripes, the central one narrow, the lateral pair broader, close to the central one, dilated anteriorly and slightly curved; viewed from above in front the whole disk of scutum, except the stripes, is whitish pollinose and also the prescutum; viewed from above and behind, the anterior dilated portion of the lateral stripes is conspicuously white pollinose; pleurae distinctly whitish pollinose except on membranous portion; scutellum opaque brown; postscutum with silky white pollinosity. Abdomen brown-black, opaque on basal four segments, subshining on apical four. Legs yellow, black as follows: Mid and hind coxae; apices of tibiae and entire tarsi of fore legs, narrowly at apices of femora; a spot at bases and broadly at apices of tibiae; apices of first and from middle of second to fifth joint of tarsi of mid and hind legs. Wings clear, thick veins brown. Halteres yellow.

Frons divergent-sided, at upper angle occupying one-fourth the head width, above antennae two-thirds as wide as at upper angle, surface hairs brownish yellow, sparse and weak; face broader than frons at upper angle, almost subquadrate, surface hairs more numerous than on frons, whitish; hairs on palpi pale brown; postocular cilia pale, with an admixture of longer, blackish hairs on upper part behind vertex. Pilosity of scutum rather loose and upright, whitish yellow, hairlike, the posterior fourth with a number of longer, upright, blackish hairs; anterior pleural hairs pale and hairlike, close to lateral margin of scutum; pleural tuft pale, confined to upper fourth, postspiracular area pale haired. Abdominal basal fringe pale yellow; surface hairs on segments sparse, pale. Legs with yellow, close-lying pilosity and longer, upright, black dorsal hairs; fore tarsi not noticeably thickened, the paired apical hairs present

on joints 1 and 3; hind tarsus of the normal shape for this genus; tarsal claws simple (Pl. II, fig. 12). Wings with dark brown hairs on veins.

Length, 4 mm.

Type.—Cat. No. 15407, U. S. National Museum.

Locality: Sierra Madre, Mexico, head of River Piedras Verdes, altitude about 7,300 feet. In ear of horse (C. H. T. Townsend), one female.

I do not think that this can possibly be the species described as *cinereum* by Bellardi from Mexico, which is stated to attack horses.

A translation of Bellardi's description is as follows:

Male and female: Gray, antennæ black, first joint pale. Thorax fuscous and gray pollinose, the humeri pale; pleura light gray, scutellum pale at the tip; halteres white. Abdomen blackish. The front coxæ pale, the middle and hind pairs grayish brown; the femora pale at base, their tips black; tibiæ black, their middle section pale; front tarsi wholly black, the middle and hind pairs with the bases of first and second joints pale. Wings hyaline. Length of body 3 mm.; extent of wings 9 mm.

It is possible that this may prove to be identical with *hippovororum*, but Bellardi's description might apply to more than one species in the genus equally well. I consider it better to have this species clearly described and give it a name by which it may be distinguished than to accept it as Bellardi's species, which may very probably prove to be something entirely different.

The early stages are unknown.

The name *cinereum* was preoccupied when Bellardi used it, and the change of name introduced by Speiser is given in the catalogue at the end of this paper.

GROUP B.

In the species of Group B the thorax, abdomen, and legs are mostly yellow. The ground color of all the species is yellow, with the thorax brown, or white, vittate, and the abdomen and legs more or less darkened.

TABLE OF SPECIES.

1. Scutum with three dark vittæ-----	2
Scutum with white vittæ or with only two anterior marginal spots-----	3
Scutum with three chocolate-colored stripes; abdomen much obscured with brown-----	<i>trivittatum</i> , p. 30.
Scutum with three deep black stripes; abdomen with three rows of black-----	<i>distinctum</i> , p. 30.
3. Scutum with only anterior spots-----	<i>notatum</i> , p. 32.
Scutum vittate-----	4
4. Larger species (from Mexico), claws with subbasal tooth--	<i>ochraceum</i> , p. 30.
Smaller species (from New Mexico and Colorado); claws simple.	<i>bivittatum</i> , p. 31.

Neither the males, except of *notatum* and *distinctum*, nor the early stages of any of these species are known.

Simulium trivittatum, new species.

Female.—Yellow, opaque. Frons and face thickly white-dusted; antennæ browned from third joint to apex; palpi brown. Scutum with three broad, parallel-sided, chocolate colored stripes, the central one not reaching to scutellum and the lateral pair not reaching to anterior margin; posterior margin of scutellum darkened in center; space between the stripes white-dusted; pleuræ brown on center and slightly white-dusted; scutellum yellow; postscutum brown, subshining. Abdomen with basal scale yellow; segments yellow, with opaque black-brown marks which leave very little of the yellow ground color visible, apical four segments not so much darkened as basal four. Legs yellow, black as follows: Apices of tibiæ and all except base of tarsi of fore pair; apices of first and second and apical three joints of mid and hind tarsi; apices of femora and apices of tibiæ of hind pair. Wings clear, thick veins yellow. Halteres yellow.

Frons divergent-sided, two-thirds as wide at above antennæ as at upper angle of eyes, surface hairs weak, yellow; face longer than frons and one-third longer than broad, surface hairs as on frons; postocular cilia pale. Scutum with very short hairlike yellow pilosity; pleural tuft yellow; scutellum with yellow pilosity and longer upright brownish hairs. Basal fringe on abdomen yellow; all segments with short, scattered, yellow hairs. Legs with pale pilosity and scattered longer dorsal hairs on tarsal joints; fore tarsi slightly thickened; tarsal claws simple. Wing venation normal.

Length, 2 mm.

Type.—Cat. No. 15408, U. S. National Museum.

Locality.—Tampico, Mexico (E. A. Schwarz).

Readily distinguishable from any described species, except *distinctum*, by the brown vittate scutum.

Simulium distinctum Malloch.

This species was described subsequent to the completion of the present paper, but the description appeared some time ago in the Proceedings of the Entomological Society of Washington, 1913, page 133. It is unnecessary to reproduce the description here. *S. trivittatum* closely resembles *distinctum*, though I believe they are distinct.

Locality.—Devils River, Texas.

A specimen from Tamaulipas, Mexico, is with some doubt referred here also.

Simulium ochraceum Walker.

Female.—Yellow, opaque. Face and frons brownish yellow, thickly white-dusted; antennæ yellow, from fourth joint to apex browned; palpi black-brown. Scutum with two white pollinose vittæ, and

laterally beyond these stripes a pear-shaped brown mark with the narrow extremity toward the wing base, which stops short of the prescutum and does not touch the white stripes; pleuræ brownish; scutellum yellow. Abdomen with the apical segments more or less blackened and subshining. Legs yellow, blackened as follows: Mid and hind coxæ; fore tarsi except base; apex of first, apical half of second, and entire apical three joints of mid tarsi; apices of femora, apical half of tibiæ, apical half of first and second, and entire apical three joints of tarsi on hind legs. Wings clear, thick veins yellow. Halteres yellow.

Frons divergent-sided, at above antennæ about one-third as broad as at vertex, bare in center, laterally and more broadly posteriorly covered with golden pilosity and among the pile some longer, upright, black hairs; face one-third longer than broad, uniformly but not thickly covered with short, yellow pilosity; antennal pilosity whitish; palpi brown-haired; postocular cilia mostly yellow, with a number of longer, black hairs. Stripes on scutum as broad at anterior margin as the space between them, gradually diverging and somewhat curved posteriorly, becoming narrower and ceasing at a little beyond middle of disk; extreme lateral margins of scutum whitish pollinose, pilosity golden yellow, scale-like and regularly distributed; no black hairs on scutum; pleural tuft brown; postspiracular area brown-haired posteriorly; scutellum with pale yellow pilosity and long, upright brown hairs. Abdominal basal fringe pale yellow, long; segments with scattered, short yellow pile and a few longer back hairs intermixed with them. Legs with close-lying yellow pilosity and scattered, longer, upright, dorsal brown hairs; fore tarsi with the normal paired apical hairs on joints 1 and 3; claws as in Plate II, figure 15. Diagrams of the thoracic elevations of this and the following two species are shown in Plate V, figures 6-8.

Length, 2 mm.

Two females, Cordoba, Mexico (E. Knab).

The records of the occurrence of this species in the United States which I have had the opportunity of examining are erroneous and refer to *notatum* Adams. (See note under *notatum*, p. 33.)

Simulium bivittatum, new species.

Female.—Ocherous, opaque. Frons and face thickly white-dusted, antennæ from apex of third joint to apex of eleventh browned, palpi brown. Scutum with two broad, almost parallel-sided, white-pollinose vittæ; extreme lateral margins of scutum white-pollinose; prescutum and scutum near to it pale yellow; pleuræ yellow, browned on middle; scutellum ocherous; postscutum black. Abdomen yellow, segments 2-6 with a distinct black dorsal spot and brown lateral

marks, apical segments subshining. Legs yellow, browned as follows: Mid and hind coxæ; fore tarsi except base; apices of first and second and entire apical three joints of mid and hind tarsi; and apices of hind femora and tibiae. Wings clear, thick veins yellow, costal vein darker. Halteres yellow.

Frons divergent-sided, at least one-half as broad above antennæ as at upper angle of eyes, surface hairs yellow; face subquadrate, nearly as wide as frons at vertex; surface hairs pale, longer toward mouth edge; antennal pilosity pale; postocular cilia yellow. Pilosity on scutum short, regular, golden yellow, longer just in front of scutellum, no black hairs on disk; pleural tuft pale; postspiracular area pale-haired posteriorly; scutellum with pilosity and upright hairs all yellow. Basal fringe of abdomen pale, apical four segments with rather distinct pale hairs. Legs haired as in *ochraceum*. Claws simple.

Length, 1-1.5 mm.

Type.—Cat. No. 15415, U. S. National Museum.

Locality of type, East Las Vegas, N. Mex., June 1, 1901 (T. D. A. Cockerell). There are also in the national collection two females from Las Vegas Hot Springs, N. Mex., August 19, 1901 (H. S. Barber), and five females from Virginia Dale, Colo., September 31, 1912, taken on cow (Bishopp).

Simulium notatum Adams.

Female.—Ocherous yellow, opaque. Frons and face thickly white-dusted; antennæ slightly darkened from fourth joint to apex; palpi ochreous. Scutum unstriped, only two small triangular spots on anterior margin and very faint indications posteriorly of the stripes of the other species, laterally a darker elongated mark on disk; pre-scutum and margins of scutum adjacent to it yellow; pleuræ darkened centrally, more distinctly near to coxæ; scutellum yellow; post-scutum black-brown. Abdomen yellow; segments, except apical three, with opaque, black dorsal spot, apical three segments slightly shining, their bases browned. Legs yellow, browned, or blackened, as follows: Fore tarsi, except base of first joint; last two joints of mid tarsi; extreme apices of hind tibiae; and apices of basal three and whole of apical two joints of hind tarsi. Wings as in *bivittatum*, but the costal vein paler. Halteres yellow.

Frons divergent-sided, two-thirds as wide at above antennæ as at upper angle of eyes, surface hairs weak, sparse, whitish; face subquadrate, surface hairs as on frons; antennal pilosity pale; hairs on palpi pale; postocular cilia pale. Scutum with very pale yellow, hair-like pilosity, which is distinctly longer just in front of scutellum; pleural tuft pale; scutellum with yellow pilosity and upright hairs.

Basal fringe of abdomen pale yellow, surface hairs on segments sparse, pale, longer on apical segments, and more numerous. Legs with pale pilosity, hairs brown, shorter, and not so numerous as in *bivittatum*, the paired apical hairs on first and third joints of fore tarsi shorter than in that species; claws simple.

Length, 1-1.5 mm.

Three females, Las Cruces, N. Mex., June 25, 1895 (T. D. A. Cockerell). These are the specimens on which the record of *ochraceum* Walker is based in Entomological News for 1897, page 100. I have not seen the specimens upon which the record at page 172 of the same volume of that publication was based, but they probably belong either to this species or to *bivittatum*.

Male.—Brown. Face white-dusted, antennæ brown, paler on basal two joints, palpi brown. Scutum opaque, evenly covered with whitish gray pollinosity; prescutum and adjoining margin of scutum yellow; pleuræ brownish yellow, whitish pollinose; scutellum yellow, margins of scutum adjoining scutellum and laterally brown; postscutum brown, with whitish pollinosity. Abdomen yellow, with dorsum of segments 1-2 narrowly, and remaining segments broadly blackened, apical three segments broadly silvered on sides. Legs yellow, browned on fore tarsi, mid and hind coxæ, apical two joints of mid tarsi, apices of femora and apices of tibiæ of hind legs (hind tarsi broken off in specimen); claws trifid. Wings clear, thick veins yellow, venation normal. Halteres bright yellow, base of stalk darkened.

Eyes with upper facets very large, with lower facets very minute, hairs on face and palpi pale, postocular cilia weak, pale. Scutum with close-lying, whitish-yellow, hair-like, regular pilosity, which is longer in front of scutellum; pleural tuft whitish; scutellum with white pilosity and longer, upright, white hairs. Abdominal basal fringe pale yellow, hairs on segments sparse, of moderate length, white. Legs with sparse, pale pilosity and scattered, longer, pale hairs; fore tarsi not distinctly thickened, the apical paired hairs weak; hind femora and tibiæ broad; hind tarsi broken off, but undoubtedly possessing the normal characters of *Simulium*.

Length, 1 mm.

Locality: Williams, Ariz. (H. S. Barber), one male.

It may be that this is really a distinct species from the female described herewith, but there are so many points of agreement that I have decided to consider it as the male of *notatum* rather than describe it as new, as I was at first tempted to. The only point which causes me to doubt the safety of this course is the absence of any indication of the white pollinose spots on the scutum, which, if the general rule holds with this group, ought to be even more distinct in this sex than in the female.

GROUP C.

Scutum unstriped, at most the anterior margin with weak indication of a central, divided stripe, and anterior lateral white spots.

TABLE OF SPECIES.

1.	Tarsal claws with a distinct subbasal tooth in addition, and anterior, to the normal tuberculate or rounded base-----	2
	Tarsal claws without subbasal tooth, only the base tuberculate, rounded, or produced thumblike (as in Pl. II, figs. 5 and 7)-----	5
2.	Thoracic pilosity arranged in irregular groups, disk with upright black hairs, in addition to pilosity, which are most distinct on anterior angles-----	<i>mexicanum</i> , p. 35.
	Pilosity not arranged in groups, regularly disposed-----	4
4.	Thoracic pilosity black or black-brown, fine and hairlike--	<i>parnassum</i> , p. 36.
	Thoracic pilosity lanceolate, scalelike, whitish or yellowish in color.	<i>arcticum</i> , p. 37.
5.	Tarsal claws produced thumblike at base-----	6
	Tarsal claws not produced thumblike at base-----	7
6.	Scutum with brassy, scalelike pilosity; base of tibiae not blackened.	<i>bracteatum</i> , p. 38.
	Scutum with yellowish hairlike pilosity; base of tibiae distinctly blackened-----	¹ <i>johannseni</i> , p. 65.
7.	Pilosity on scutum arranged in punctiform groups, the scales short and broad, small species-----	<i>exiguum</i> , p. 39.
	Pilosity on scutum not arranged in punctiform groups, either regularly or irregularly disposed-----	8
8.	Scutum with irregularly disposed golden yellow pilosity and upright brown hairs on disk-----	<i>clavipes</i> , p. 40.
	Scutum with regularly disposed pilosity, discal hairs absent-----	9
9.	Small species (1-1.5 mm. in length); mid tarsi almost all pale; third joint of hind tarsi pale; scutum with pearlaceous pollinosity.	<i>jenningsi</i> , p. 41.
	Larger species (2-4 mm. in length); mid and hind tarsi black, except bases of first and second joints; scutum with whitish pollinosity----	10
10.	Scutum more or less shining, the anterior margin at center with indications of a divided stripe; pilosity yellow-----	<i>venustum</i> , p. 43.
	Scutum not shining, no indications of a central stripe; pilosity whitish.	<i>piscicidium</i> , p. 45.

Simulium tarsale Williston belongs to this group, but from the description I am unable to place it in the table. In all probability it is distinct from any of those included in my table, but nothing is said of the tarsal claws and certain other essential characters in Williston's description, so that it is impossible to decide its status. The species belonging to this group are the most widely distributed and most closely allied of the Simuliidae. It is to this segregate that *reptans* Linnaeus and several other European species belong.

¹ I have included *johannseni* here as well as in the group with vittate scutum, as it is closely allied to *bracteatum* in the formation of the claws, but the coloration as given above, though of alcoholic specimens, is quite distinct from that of *bracteatum*, as is also the vestiture of the thorax. For description see pp. 65-66.

Simulium mexicanum Bellardi.

Female.—Black, subopaque, only the apical four abdominal segments distinctly shining. Frons and face white-dusted; antennæ brown, with basal two joints and base of third joint yellowish; palpi brown. Prescutum yellowish, pleuræ with sutures and posterior portions yellowish; scutellum brownish yellow; postscutum brown, whitish pollinose; scutum unstriped and weakly white-dusted. Abdomen with basal scale opaque black; first segment below scale yellow or brown at base, opaque black at apex; segments 2–4 grayish pollinose, with opaque black fasciæ, which are broadest at middle and taper on each side; apical four segments glossy black; venter brownish yellow. Legs black, yellow as follows: Coxæ, femora, and bases of tibiæ of fore pair; apices of coxæ, trochanters, bases and apices of femora, basal halves of tibiæ, and basal halves of first and second joints of tarsi of mid and hind pairs; base of third joint of mid tarsi. Wings grayish, thick veins brown. Halteres yellow, darkened at base of stalk.

Frons almost parallel-sided, not one-third as wide at vertex as the breadth of head, surface hairs black; face longer than frons and wider than frons at upper margin, one-third longer than wide, surface hairs black; hairs on palpi brown; postocular cilia black. Scutum with brassy yellow, scalelike pilosity, which is arranged in irregular groups on the disk; besides the pilosity there is on the disk short, closely placed, black, upright hairs, which are most distinct on the margins; pleural tuft black or brown; postspiracular area pale-haired; scutellum with yellow pilosity and longer, upright black hairs. Basal fringe of abdomen yellow, apical four segments with short black hairs, which are longer at extreme apex. Legs with close-lying yellow pilosity and long, upright, black dorsal hairs, which are very noticeable on the apices of the tarsal joints; fore tarsi with the normal paired apical hairs on joints 1 and 3; the legs are strong and the fore tarsi very distinctly thickened or compressed laterally; tarsal claws with subbasal tooth (Pl. II, fig. 6).

Length, 4 mm.

Two females, Cordoba, Mexico, January 30, 1908 (F. Knab).

These specimens agree so closely with the description given by Bellardi¹ that I have no hesitation in associating them with his species. The early stages are unknown.

A translation of Bellardi's description of the male of *Simulium mexicanum* is as follows:

Black. Head black, frons prominent, triangular, with whitish reflection; antennæ black, first joint and base of second [second and base of third ?] yellow; face prominent, black, the epistome yellowish, with grayish reflection; palpi

¹ Saggio di Ditterologia Messicana, App. 6, 1862.

black, paler at the base; thorax wide, subquadrate, slightly convex, black, with a grayish reflection, and golden scales; humeri pale; pleuræ black, anteriorly and posteriorly, with fuscous spots; scutellum fuscous; halteres white; abdomen black, base of second segment pale yellowish on the sides; fore and middle coxæ wholly yellow, hind ones fuscous, with yellow tips; fore femora wholly yellow, mid and hind pairs fuscous-black, with yellow bases; fore tarsi wholly black; middle tarsi black, with bases of all the joints yellow; hind tarsi black, with base of first joint broadly and of second joint narrowly yellow; wings hyaline, iridescent. Length 4 mm., alar expanse 9 mm.

Simulium parnassum, new species.

Female.—Black, slightly shining; prescutum paler; pleuræ pale along the sutures; abdomen opaque black on basal four segments, shining on apical four; legs black, yellowish as follows: Coxæ, trochanters, bases of tibiæ, and base of first joint of tarsi of fore legs; apices of coxæ, bases of trochanters, bases of femora, of tibiæ narrowly, and of first tarsal joint of mid legs; trochanters, bases of femora and of tibiæ, basal two-thirds of first and basal half of second joint of hind legs. Halteres yellow, stalk dusky at base.

Frons glossy black, sides divergent, about one-third wider at vertex than above antennæ, surface hairs strong, upright, black, present only on lateral margins, especially toward vertex, absent from center; face distinctly longer than broad ($1\frac{1}{3}:1$), grayish pollinose, almost bare on center, with long hairs on lateral and lower margins; antennæ brown, the basal two joints and base of third generally paler; second and third joints elongated, subequal, as long as $4+5$; pilosity short, thick, pale; palpi black-brown, black haired; post-ocular cilia black. Mesonotum with very slight pale pollinosity; pilosity black or black-brown, close-lying, regular, in the depression on posterior fourth the hairs much longer and upright; pronotum with numerous black hairs, episternum immediately below it with pale hairs; all the lower parts of pleuræ with silky pollinosity; pleural tuft brown-black, confined to upper fourth; scutellum opaque black, the upright hairs black, no pale hairs present. Abdominal basal scale varying in color from pale yellowish to opaque black, the long hairs pale brownish yellow; membrane beneath scale generally yellow; some specimens have the abdomen inclining to brown; segments almost bare except laterally and apically where there are numerous brown hairs. Legs with close-lying pale pilosity and distinct, longer, upright, black hairs on the dorsal surfaces of femora, tibiæ, and tarsi; the usual paired apical hairs on first and third fore tarsal joints present (Pl. V, fig. 11); hind tibiæ at apices and basal three-fourths of first tarsal joint of hind legs with short, stiff, upright, golden pile; claws with tooth (see Pl. II, fig. 8); wings clear, thick veins brownish, cross-vein at two-fifths from apex of subcosta.

Length, 2-2.5 mm.

Type.—Cat. No. 15409, U. S. National Museum.

Type locality, Red Hill, Moultonburgh, N. H., August 5 (H. G. Dyar). There are specimens from Skyland, Page County, Va., July 15, 1912 (H. G. Dyar), and White Mountains, N. H. (Morrison).

The male and the early stages are unknown.

Simulium arcticum, new species.

Female.—Black; frons shining, very slightly dusted with white, face thickly white dusted, antennæ with two basal joints yellowish. Scutum with two large and generally distinct white pollinose spots on anterior angles of scutum, the latter slightly shining; pre-scutum brownish; scutellum concolorous with scutum; pleuræ sub-opaque, distinctly white-dusted, especially on lower portions. Abdomen black, opaque on basal four segments, shining on apical four. In some specimens distinctly gray-dusted laterally and posteriorly on basal five segments. Legs yellow, black as follows: Femora except bases, tibiæ at apices and tarsi of fore legs; coxæ, femora except bases, apical third of tibiæ, and apices of first tarsal joint of mid and hind legs; last four joints of mid tarsi, except extreme base of second; last four joints of hind tarsi except basal half of second. Wings clear, thick veins brownish. Halteres yellow, brownish at base of stalk.

Frons with sides very slightly divergent, unusually broad at antennæ above, occupying about one-fourth the width of head, at vertex about one-third as wide as head, surface hairs only on lateral margins; besides the scale-like hairs there are also present some black, upright hairs; face as broad as frons at vertex, and about one-third longer than broad, surface hairs whitish, absent from upper third, antennal pilosity pale; palpi black, hairs black-brown; postocular cilia pale, with a few intermixed black hairs on lower portions. Scutum covered with close-lying whitish or yellowish pilosity which is regularly arranged and rather long; prescutellar depression of scutum with numerous long, upright, black hairs; pleural tuft pale; scutellum with pale scale-like pilosity and numerous long, upright, black hairs. Abdominal basal scale paler than rest of abdomen, the fringe long and pale, surface hairs on apical segments pale and on lateral margins a number of long black hairs. Legs with rather long, close-lying, pale pilosity and numerous long, upright, black dorsal hairs, those on apices of first and third fore tarsal joints not conspicuous; claws with subbasal tooth (see Pl. II, fig. 4). Wing venation as in *parnassum*.

Length, 3-4 mm.

Type.—Cat. No. 15410, U. S. National Museum.

Type locality, Kaslo, British Columbia (H. G. Dyar). Also from London Hill Mine, Bear Lake, British Columbia (R. P. Currie).

The male and the early stages are unknown.

Simulium bracteatum Coquillett.

Female.—Opaque black or brown-black; basal two joints of antennæ yellow, palpi black-brown. Prescutum and margin of scutum bordering on it yellowish, pleuræ brown, yellowish posteriorly, darker on lower central portions, scutellum and postscutum black-brown. Abdomen opaque black-brown. Legs yellow, darkened on apices of all femora and tibiæ, entire fore and mid tarsi except extreme base of latter, and apices of first and second and all remaining joints of hind tarsi. Wings clear, thick veins yellowish brown. Halteres pale yellow, darkened at base of stalk.

Frons rather narrow, sides divergent, less than one-third the width of head at upper angle of eyes, and more than one-half as wide at lower angle as at upper, surface covered with close-lying, thickly placed, brassy yellow, scalelike pilosity; face paler in color than frons and equal to it in length, distinctly longer than broad, pilosity rather paler and looser than that of frons, antennal pilosity pale; hairs on palpi brownish. Scutum unstriped, pilosity very close, rather scale-like, brassy yellow in color; pleural tuft pale yellow; scutellum with close-lying yellow pilosity and long, upright yellow hairs; postscutum with yellow pilosity. Abdomen with close pilosity, on all segments, of a similar nature to that on mesonotum, apical segment with longish hairs. Legs with close-lying yellow pilosity on the yellow parts, which is longer on the dorsal surfaces, and brown hairs and pilosity on the dark portions; claws as in Plate II, figure 14 (*Prosimulium pecuarum*); hind tarsi with basal joint produced at apex and second with scale and basal constriction.

Length, 2.5–3 mm.

Redescribed from type specimens, Cambridge, Mass., May 31, 1869. There is also one female in the collection from Plummers Island, Md., April 19, 1903 (H. S. Barber), one female from Franconia, N. H. (Mrs. A. T. Slosson), and one female from Los Angeles, Cal. (collection Coquillett).

There are several males and one female in the collection of the Illinois State Laboratory of Natural History from Algonquin, Ill. (Nason).

Male.—Opaque black. Head in type broken off. Scutum with indistinct anterior whitish dusting, prescutum yellowish, pilosity brassy yellow, rather more hairlike than in female and distinctly longer, lateral margins of scutum brownish, pleural tuft pale yellow, scutellar pilosity and hairs long, yellow, postscutum bare. Abdominal basal fringe long, yellow, all segments with long yellow pilosity, that on basal four segments laterally very thickly placed and adhering closely to surface, apical four segments with pilosity much shorter and sparse. Legs brown, apically the joints slightly dark-

ened, pilosity yellow, on fore tibiæ dorsal surfaces silvery, dorsal surfaces of all joints with longer, upright, pale hairs, fore tarsi not distinctly thickened, hind tarsi with basal joint slightly thinner than tibiæ and produced at apex posteriorly, second joint with basal scale and excision; claws trifold. Wings as in female. Halteres brown.

Length, 3 mm.

Locality: Los Angeles, Cal. (collection Coquillett).

In the original description of the male of this species there are so many details left out that I have considered it better to redescribe it.

I have not seen the larva or pupa of this species, but Mr. E. H. Strickland has reared it in Massachusetts. His description of it agrees in both stages very well with that given by Hart for *S. johannseni*.

The larva differs from that of other species of *Simulium*, except *johannseni*, in having the outer tooth on each side rounded and with an apical pointed process. The lateral setæ number two on each side. The pupa has only four respiratory filaments, and should be readily recognizable from any other North American species except *johannseni* by that character alone.

I have not seen the specimens reared by Strickland and have to accept his published authority for the identification.

Simulium exiguum Roubaud.

Female.—Black, subshining. Frons very slightly dusted, face distinctly whitish pollinose, antennæ yellow, basal joint and apical joints slightly browned, palpi yellow, brown at apex. Scutum undusted, pleuræ with distinct pearlaceous pollinosity, postscutum whitish pollinose. Abdomen black, segment below basal scale entirely covered with pearlaceous pollinosity, next segment opaque, the remainder glossy on disk, with slight indications of whitish pollinosity on lateral margins. Legs yellow, blackened on mid and hind coxæ, fore tarsi from apex of first joint to tip, last joint of mid tarsi, middle of femora, apices of tibiæ, ventral surfaces of first joint at apex and last joint of tarsi of hind legs. Wings clear, thick veins yellow. Halteres yellow.

Frons with sides very slightly divergent posteriorly, occupying at upper angle of eyes less than one-third the head width; face much more elongate than usual, nearly twice as long as broad, as broad as frons at lower angle; both face and frons with extremely weak surface hairs; occiput with pearlaceous pollinosity; postocular cilia weak, dark. Scutum with iridescent, golden yellow, rather broad, scalelike pilosity which is arranged in irregular groups; pleural tuft weak, brown; scutellum with similar pilosity to scutum and some long, upright, brown hairs. Abdominal basal fringe short, sparse,

brown, apical segments with sparse, dark surface hairs. Legs with pale yellow hairlike pilosity and a few longer, upright, brown dorsal hairs, the normal paired apical hairs present on first and third joints of fore tarsi; fore tarsi slender, hind tarsi with apical four joints three-fourths as long as basal joint; tarsal claws simple. Hairs at base of first vein black, surface hairs on veins black, anal wing fringe whitish.

Length, 1.5–2 mm.

Four females, Sarare, Venezuela (T. Gray), examined by Roubaud; four females taken on board ship 4 miles off Livingston, Guatemala, March 20, 1906, one female, Cacao, Trece Aguas, Guatemala, and one female, same locality, April 12, 1906, labeled "Biting man" (Schwarz and Barber).

This very prettily marked species can not be confounded with any other which I have examined.

The male and the early stages are unknown.

Simulium clavipes, new species.

Female.—Black, subopaque. Frons and face distinctly white-dusted; antennæ brown, the basal two and base of third joints yellow; palpi brown, pale at base. Scutum in some specimens with faint indications of a central stripe and anteriorly with slight whitish pollinosity; scutum shining posteriorly, prescutum yellow; pleuræ brown, darker anteriorly and with whitish pollinosity; scutellum and post-scutum brown, the latter with white pollinosity. Abdomen black, opaque on basal four segments, glossy on apical four. Legs yellow, black on mid and hind coxæ, apices of all tibiæ, and entire tarsi, except base of first joint of mid tarsi, and greater part of first and basal half of second joint of hind tarsi. Wings clear, thick veins brown. Halteres yellow.

Frons slightly divergent-sided, three-fourths as wide at lower angle as at upper, surface hairs brown, sparse, upright; face subquadrate, as broad as frons at lower angles and similarly haired; hairs on palpi brown; postocular cilia brownish black, strong. Scutum with golden yellow pilosity which is rather loose and irregularly arranged, though not grouped; besides the pile there are regularly arranged brown hairs over the entire disk, which are much more distinct on margins and especially posteriorly; pleural tuft brown, sparse; scutellum with yellow decumbent pilosity and long, upright brown hairs. Basal fringe of abdomen yellow, surface hairs on apical segments pale brown, sparse. Legs strong, clothed with yellow pilosity, and with numerous longer, upright, dorsal brown hairs which are more noticeable on tibiæ and tarsi; fore tarsi broad, first and third joints with paired apical hairs; hind tarsi with basal joint narrower than tibiæ,

apical four joints about two-thirds as long as basal joint; tarsal claws as shown in Plate II, figure 5.

Length, 3-4 mm.

Type.—Cat. No. 15411, U. S. National Museum.

Locality.—Guadeloupe, West Indies, 4,000-foot level, July (August Busck).

It is improbable that this is the species described as *S. tarsale* by Williston, the description of which is given on pages 46-47. The size, color, and locality are quite enough to justify me in separating it, even if the vestiture were overlooked by Williston in describing his species in so far as the presence of the upright brown hairs on scutum are concerned.

The early stages of this species are unknown, and there are no males among the material in the collection.

Simulium jenningsi, new species.

Female.—Black, shining. Frons and face shining, the former slightly, the latter distinctly white-dusted; antennæ brown, basal three joints paler, yellowish; palpi brown. Scutum shining black, with distinct pearlaceous pollinosity, which does not form spots, but is most distinct near margins of prescutum and tapers off toward center of disk; pleuræ glossy black, distinctly whitish pollinose on lower central portions; scutellum velvety opaque black; postscutum whitish pollinose. Abdomen with basal four segments opaque black, apical four glossy black. Legs black, yellow as follows: Coxæ, bases of femora narrowly, and at bases of tibiæ broadly of fore legs; trochanters, bases of femora, bases of tibiæ broadly, and basal three tarsal joints except apices, on mid and hind legs. All tibiæ silvered on basal half of dorsal surface. Wings clear, basal portions of veins brown, thick veins yellow. Halteres with lemon-yellow knob and brown stalk.

Frons broad, distinctly more than one-third as wide at upper angle of eyes as head width, slightly divergent-sided, hairs sparse, pale, confined to lateral posterior margins; face slightly narrower than frons at widest part, about one-third longer than wide and as long as frons, surface hairs pale, sparse, though more numerous than on frons; hairs on palpi pale; postocular cilia brown. Scutum with yellow, sparse, rather widely placed, regular hairlike pilosity, no long posterior hairs on scutum; pleural tuft sparse, short, brownish; postspiracular area bare; scutellum with upright brown hairs. Basal abdominal fringe brownish yellow, surface hairs on apical four segments sparse, yellowish. Pilosity on legs yellow, except on the basal half of dorsal surfaces of tibiæ where it is white, giving the silvery appearance which is so noticeable in this and allied species; the

usual longer dorsal hairs weak; fore tarsi dilated, as broad as tibiae, first and third joints with paired apical hairs; hind tarsi of similar form to *venustum* Say; claws simple. Wing venation normal, surface hairs and short bristles brownish yellow. Sometimes the pilosity on scutum is brownish or almost black, but this is exceptional.

Length, 1-1.5 mm.

Type.—Cat. No. 15412, U. S. National Museum.

Male.—Similar in size and color to the female except that the mesonotum is velvety opaque black; the scutum has two silvery or pearly stripes running from the margin of the prescutum backward and inward to almost middle of disk; the lateral and posterior margins of scutum are distinctly silvery pollinose; the pilosity is darker and longer, being more hairlike than in female. The abdomen is not distinctly shining on apical segments, and the hairs are longer and darker. The legs are similar in color to those of the female, but the tibiae are only pale at extreme base; they are longer haired and the claws are trifid (see Pl. V, fig. 12). The eyes are of similar formation to those of the males of *venustum*.

Allotype.—Cat No. 15412, U. S. National Museum.

There are reared specimens in the collection bearing the number 4425. These emerged from pupæ sent to the Bureau of Entomology in May, 1889, from Friersons Mill, La.

An examination of the pupa discloses the fact that this is in all probability the species described in the larval and pupal stages by Johannsen in the paper already mentioned. I give a copy of the characters mentioned by Johannsen for his variety *a* of *venustum*, which he was unable to separate from the type except by size in the imago.

A number of specimens bred from larvæ and pupæ taken from Fall Creek, Ithaca, New York, differs in the adult stage from *venustum* as described above in being uniformly smaller (length 1.5 mm.); having the base of wing brownish and not yellow, and in having the last four abdominal segments of the female a shining black instead of brown. The larva differs as follows: in size averaging less than two-thirds that of *venustum*, labrum [labium] with its toothed edge wider in proportion to its size than in *venustum*, its teeth more nearly of a size, the ventral setæ three in each row, plus a very small one. The pupa differs in having 10 respiratory filaments in each tuft, the hooks on segment 2 more distinct, and the tubercles on the anal segments apparently wanting.

This species stood in the collection as *S. venustum* Say, and both sexes are represented among the specimens reared from the pupæ from Friersons Mill. There are specimens in the collection from Spring Hill, Fairfax County, Va.; Chevy Chase, Md., July 4, 1907; Cabin John, Md., May 16, 1909; Beltsville, Md., September 21, 1911; and Washington, D. C., July 3, 1910 (F. Knab); Minnesota (Lugger); Inman, Spartanburg, and Gramlin, S. C.; and Flat Rock, N. C. (Jennings and King); and Biscayne Bay, Fla. (Mrs. A. T.

Slosson). There are several specimens of both sexes in the collection of the Illinois State Laboratory of Natural History from Algonquin, Ill. (Nason).

This species attacks horses and is a persistent biter in South Carolina, according to the observations of Messrs. Jennings and King. Their data for the adults of the species on which observations were made are as follows:

Lot 382. Gramlin, S. C., August 19, 1912. Two dozen *Simulium* adults collected in ears of a horse. Owner lives some distance out in the country. He gave a history of being bitten by these flies. His team had come from the farm a couple of hours before. No larvæ or pupæ.

Lot 383. Gramlin S. C., August 19, 1912. *Simulium* adults from ears of a horse, collected as horse was passing along the road. No larvæ or pupæ. Driver gave no history of being bitten by the flies.

Lot 214. Flat Rock, N. C., June 5, 1912. *Simulium* adults taken while attacking a horse. Were entering ears and biting on face, neck, and shoulders also. (No larval or pupal material.)

Lot 220. Flat Rock, N. C., June 4, 1912. *Simulium* adults taken while attacking a horse. After removal of horse they continued to dance in small swarms about the same spot. Situation shaded by tall trees. (No larval or pupal material.)

The dates of occurrence of this species range from May 6 on the Louisiana specimens to September 21 on those from Beltsville, Md., and from the continuity it is evident that there must be many broods or an unintermittent reproduction during the entire summer.

The figures given on page 16 of Bulletin 159 of the Kentucky Agricultural Experiment Station by Garman are evidently details of the larva of this species, though the pupa figured on page 15 belongs either to *meridionale* or *venustum*.

Simulium venustum Say.

Female.—Black; frons glossy black, with very little dusting, face black, distinctly white dusted, antennæ with basal three joints yellowish, palpi black. Scutum shining black, with slight whitish pollinosity, especially anteriorly and on sides, prescutum yellowish or brownish, pleuræ black, white dusted, scutellum opaque black. Abdominal basal scale opaque black or brown, basal four segments velvety black, apical four glossy black. Legs yellowish, black as follows: Mid and hind coxæ; femora more or less at apices; tibiæ or apical halves; entire fore tarsi; apices of basal, most of second, and all last three joints of mid and hind tarsi. All tibiæ silvered on dorsal surfaces. Wings clear, basal portion and thick veins brown. Halteres whitish yellow.

Frons very sparsely haired on sides only, about one-half as wide above antennæ as at vertex; face nearly as broad as frons at vertex and very slightly longer than broad measured from highest point in center to mouth margin, the surface hairs black; antennal pilosity

white; hairs on palpi brown; postocular cilia pale, with a considerable admixture of black hairs. Scutum with a slight indication of a central black stripe in front; pilosity very close and short, yellow, the normal long upright hairs on posterior depression inconspicuous; plural tuft brown; post-spiracular area pale haired; scutellum with yellow pile and long upright black hairs. Abdominal basal fringe pale brownish yellow; segment beneath scale silvered, yellowish except at apex; apical segments with numerous short brown hairs which are longer on lateral margins. Fore tarsi flattened, the normal paired apical hairs present, surface pilosity pale and short, the upright hairs not very conspicuous; claws simple. Wings with brown hairs at base of first vein.

Length, 2-2.5 mm.

Male.—Opaque black. Antennæ black, the basal two joints and base of third joint yellowish. Scutum velvety black, posterior and lateral margins with silvery pollinose dusting, disk with an oblique backward and inwardly directed white stripe which stops short of middle, pilosity yellowish brown. Abdomen with basal fringe brownish; segments opaque black; first segment, below scale, pearlaceous pollinose; apical ventral segments similarly pollinose. Legs black; anterior tibiæ with basal half yellow, and whitish pollinose on the dorsal surface, hind and mid tibiæ only yellow at bases (Plate V, fig. 1); fore coxæ, base of basal mid tarsal joints, and bases of basal and second hind tarsal joints yellow; claws trifid. Otherwise as in the female, except in the confluent eyes.

Larva.—Yellow, with dark cross-bands on the segments. Fans with about 60 rays. Labium with middle tooth longest, the outer one slightly shorter, and the three intervening teeth considerably smaller.

Pupa.—Respiratory filaments six in number (Pl. IV, fig. 3). Cocoon shaped like a small conical pocket and attached to leaves or stems of plants growing in the water. The cocoons are very closely placed and almost identical with those of *vittatum* and *jenningsi*.

This is one of the commonest species in the genus. There has been much confusion regarding the identity of this and closely allied species, and possibly there is more than one species among those I have before me. An exhaustive study of the early stages may settle this question, but the material before me at present does not permit of my forming a definite opinion as to the specific distinctions of some of the specimens. I have described the male and female above from the same lot of reared specimens, the larvæ and pupæ of which agree with those described by Johannsen. The species was originally described by Say from Shippingsport, Falls of the Ohio.

The material in the U. S. National Museum collection is from the following localities: White River, Ontario, and Oxbow, Saskatche-

wan, Canada, June, 1907 (F. Knab); St. Louis, Mo., May 6, 1904 (W. V. Warner); Congaree, S. C., March-April, 1912; Abbeville, S. C., April, 1912; Greenwood, S. C., April, 1912; Columbia, S. C., April, 1912; Tacapaw Mills, S. C., August 28, 1912; Spartanburg, S. C., July 15, 1912 (reared); and Greenville, S. C., May, 1912 ("taken ovipositing in stream") (Jennings and King). Specimens in the Illinois State Laboratory of Natural History collection are from Algonquin and Havana, Ill.

The figures given by Garman¹ are evidently those of the larva of *jenningsi* and not *venustum*. The larva and pupa described by Johannsen in his paper as *venustum* var. *a* are those of *jenningsi*.

Simulium piscicidium Riley.

Female.—Black, subopaque. Frons and face with distinct white pollinosity; antennæ brown, basal two joints yellowish; palpi brown. Scutum with white pollinosity on anterior lateral angles posterior to prescutum; prescutum sometimes brownish or yellowish; pleuræ whitish pollinose; scutellum brown or yellowish; postscutum whitish pollinose. Abdomen with basal four segments opaque, the apical four shining, but not glossy; lateral posterior margins of first four segments white pollinose. Legs yellow, blackened as follows: Mid and hind coxæ; apices of femora slightly; apices of tibiæ of all legs distinctly; fore tarsi entirely; entire mid tarsi except base of first joint; hind tarsi except basal two-thirds of first and base of second joint. Wings clear, thick veins yellow, venation normal. Halteres yellow, base of pedicel darkened.

Frons divergent-sided, one-third as wide at upper angle of eyes as head width, two-thirds as wide at lower angle as at upper, surface hairs sparse, white; face as long as frons, about one-third longer than broad, haired as frons; hairs on palpi pale; postocular cilia mostly pale, with a few longer, black hairs intermixed. Scutum with short, hairlike, white, regular pilosity, the hairs on posterior fourth not conspicuous; pleural tuft whitish; postspiracular area sparsely pale haired; scutellum with long, upright, brownish hairs and closely-lying pale pilosity. Abdominal basal fringe yellow; surface hairs on segment short, pale, those at apex longer and dark. Legs with pale pilosity and longer, upright, dorsal, brownish hairs; fore tarsi dilated, the apical paired hairs present on joints 1 and 3; claws as in *venustum*. Hairs and short bristles on vein surfaces of wings brownish.

Length, 3-4 mm.

Male.—Deep black. Face silvery pollinose; antennæ entirely black; palpi black. Scutum, viewed from in front, with two black, sub-triangular marks on the anterior margin, the space between them with a dull brown stripe which shows conspicuously against the white

¹ Bul. 159, Ky. Agr. Exp. Sta., 1912, p. 16.

pollinose disk; on each side of this central stripe there is a black stripe which is slightly dilated anteriorly, does not extend either to anterior or posterior margin, and becomes diffuse brownish on margins; viewed from behind the two small, subtriangular spots are bright silvery; the whole disk, except on the aforementioned black stripes, white pollinose. Scutellum slightly white dusted; postscutum silvery. Abdomen with the segment below basal scale and sides of 5 and 6 more or less broadly silvered. Legs black; tibiæ white on dorsal surface; bases of all tibiæ yellow, the hind pair very noticeably yellow on basal half; base of first joint of mid tarsus, all except apex of first joint of hind tarsus, and base of second of the latter yellow.

The pilosity of the scutum is hairlike, pale yellowish, longer posteriorly; there are no black hairs present either on the disk or on the scutellum. Basal abdominal fringe brown. Legs rather slender; fore tarsus slender, the apical hairs not noticeable.

I have not seen the larva of this species, but it is described by Johannsen as having the teeth on the labium more nearly of an equal size than in *venustum*, and the ventral surface of same with seven setæ in each lateral row. The pupa has the respiratory organs with eight branches (Pl. VI, fig. 5). The cocoon is similar to that of *venustum*.

Piscicidium was originally described from Mumford, N. Y., by Riley, and was at one time considered to be, in the larval stage, responsible for the death of young trout. This has been proved to be a mistake. Two specimens of the original series only, marked type, are in the collection. There are also several specimens in the collection from Pine River, Lake Superior, September 7, 1896 (Hubbard); Kukak Bay, Alaska (T. Kincaid); and Lake View, Miss., April 10, 1886.

Coquillett considered this species as synonymous with *venustum* Say, and Johannsen, though possessing larvæ and pupæ, was unable to separate it from Say's species in the perfect state. There is not the slightest doubt that it is a distinct species, possessing characters in all the stages which easily separate it from *venustum*.

I have drawn up the description of the male from a specimen of *venustoides* Hart, which is, I am convinced, synonymous with *piscicidium*. The specimens in the collection of the Illinois State Laboratory of Natural History are from Algonquin, Ill., May, July, August, and October (Nason).

This is in all probability the species recorded as being such a persistent biter in the Lake Superior district.

Simulium tarsale Williston.

The following is a copy of Williston's original description:

♀. Abdomen black, the proximal segments opaque, the distal four segments shining. Length 2 mm,

Front and face black, with a light gray reflection. Antennæ yellow; the distal joints somewhat brownish. Mesonotum deep black; in front, opaque with a silvery shimmer, and with sparse, curly, golden-yellow tomentum; behind, shining. Pleuræ black, whitish pruinose. Abdomen black, the basal segments opaque, the distal four segments somewhat shining, and with a delicate whitish pruinosity. Legs reddish-yellow; tarsi black, except that the proximal half of the middle and hind metatarsi light yellow; first and third joints of the front pair each with two long hairs; second and third joints of the same pair dilated, the fourth and fifth very small; hind metatarsi elongate and stout, the following two joints a little dilated, the fourth and fifth small. Wings hyaline, veins yellow.

This species must belong to the group which is represented by *venustum* Say, and several other closely allied forms, but it is not possible to say just what species the author had before him at the time he wrote his description. I have not seen any species from St. Vincent, which is the type locality of *tarsale*, and can not be certain as to its status. It is, however, highly improbable that it is the *pulchrum* which Philippi described from Chile,¹ as suggested by Hunter.

GROUP D.

Scutum striped, the stripes three or five in number (or one central stripe, *griseum*), the dorso-lateral pair curved, dilated at anterior ends, and generally with the dilated portion white-pollinose, the central stripe generally linear.

TABLE OF SPECIES.

- | | |
|--|-----------------------------|
| 1. Scutum with pearlaceous pollinose stripes..... | <i>metallicum</i> , p. 48. |
| Scutum with black or brown stripes; if these are pollinose they are never metallescent or pearlaceous..... | 2 |
| 2. Claws with the base prolonged thumblike..... | 3 |
| Claws with the base dilated or slightly tuberculate, or with a small subbasal tooth in center in addition to the tuberculate base..... | 5 |
| 3. Larger species, 3-4 mm.; abdomen with long hairs laterally, and the black marks showing as a series of black spots on the sides. | |
| | <i>johannuseni</i> , p. 65. |
| Smaller species, 2-3 mm.; abdomen with the black marks forming fasciæ..... | 4 |
| 4. Outer vittæ on scutum much curved, basal scale of second hind tarsal joint indistinct..... | <i>meridionale</i> , p. 49. |
| Outer vittæ slightly curved, basal scale distinct..... | <i>forbesi</i> , p. 63. |
| 5. Claws simple..... | 6 |
| Claws with central tooth..... | 6 |
| 6. Scutum black, thickly white-dusted, one central black stripe on disk; abdomen yellow, with black dorso-central spots..... | <i>griseum</i> , p. 52. |
| Scutum with at least three stripes, not thickly white-dusted; abdomen never yellow..... | 7 |

¹Aufzählung der chilenischen Dipteren, 1865, p. 633.

7. Scutum with five very distinct brown stripes on a light gray ground ----- *vittatum*, p. 53.
 Scutum with three less distinct stripes, ground color dark gray ----- *pictipes*, p. 55.
 8. Legs mostly yellow ----- *virgatum*, p. 57.
 Legs mostly black ----- *hunteri*, p. 59.

Simulium metallicum Bellardi.

Female.—Black, shining. Frons glossy, only slightly pollinose; face thickly covered with pollinosity which is slightly pearlaceous in color; antennæ with the basal two joints and most of third joint yellow. Scutum with three stripes, the central one narrow, the lateral ones anteriorly dilated and posteriorly divergent, then curved inward and ending at about last third of scutum; viewed from behind these stripes are iridescent or pearlaceous in color; from in front they are opaque black, and the remainder of scutum is pearlaceous; prescutum brownish; pleuræ with pearlaceous dusting, glossy black; scutellum brownish opaque; postscutum with pearlaceous dusting. Abdomen black, opaque on basal four segments, glossy black on apical four, side of first segment under basal scale with pearlaceous dusting, next three with narrow, lateral, whitish, posterior margins. Legs black, yellow as follows: Coxæ at apices, trochanters, and femora of fore pair; trochanters, bases of tibiæ, most of basal, second, and third joints of tarsi of mid pair; trochanters, bases of tibiæ, all but apex of first, and basal half of second tarsal joints of hind pair. All tibiæ silvery white dusted on dorsal surfaces. Halteres bright yellow, stalk brown. Wings clear, basal veins brown, thick veins yellow.

Frons slightly divergent-sided, less than one-third as wide at upper angle of eyes as width of head, surface hairs sparse, brown; face nearly as long as frons and one and one-half times as long as broad, surface hairs pale brown; hairs on palpi brownish; postocular cilia brown. Scutum with sparse, yellow, decumbent, scale-like pilosity which is longer posteriorly; pleural tuft weak, brown; scutellum with long, upright, brown hairs on hind margin. Abdominal basal fringe rather short, yellowish, surface hairs on abdomen sparse, brown. Legs with brownish-yellow pilosity and scattered, upright, dorsal, brown hairs; fore tarsi dilated, basal joint as broad as tibia, and like the third furnished with the apical paired hairs; claws as shown on Plate II, figure 17. Thick veins of wings with black-brown surface hairs and short bristles, thin veins very indistinct.

Length, 2 mm.

There are quite a number of specimens in the collection which I consider are referable to this species. The localities are: Trinidad, West Indies (F. W. Urich); Arroyo di los Nogales, Chihuahua, Mex. (C. H. T. Townsend); San Jose, Costa Rica, Cordoba, and

Orizaba, Mex. (F. Knab); Livingston and Alta Vera Paz, Guatemala (Schwarz and Barber).

A translation of Bellardi's description of the male of *Simulium metallicum* is as follows:

Metallic blue-black. Base of antennæ, halteres, fore femora, middle portions of fore tibiæ, bases of mid and hind tibiæ; and bases of first and second joints of mid and hind tarsi white. Wings hyaline, veins rather indistinct. Length of body, 2 mm.; wing expanse, 5 mm.

Nothing is said as to whether the thorax is striped or not. Roubaud found a female in the Paris Museum, belonging presumably to the original lot from which the male was described, and published a description of it in 1906.¹ He did not redescribe the male.

Larva.—Similar in color to those of *venustum* and *jenningsi* and about the same size as the latter. The labium is of the same type as those of this group also, but the intermediate teeth between the central and outer teeth are very small; in this respect it is more closely allied to *venustum*, though there appear to be only three distinct lateral ventral setæ, as in *jenningsi*.

Pupa.—The species has eight respiratory filaments, but these differ in the branching from *piscicidium*, as shown in Plate VI, figure 4. The cocoon is similar to that of *venustum*, closely woven and found on leaves and stems of plants.

The foregoing details are drawn from material sent in by Mr. F. W. Urich, from Trinidad, along with imagines of this species.

Simulium meridionale Riley.

Female.—Gray, or brown-black with very thick gray dusting, opaque; antennæ and palpi brown-black, the former but little paler at base in some specimens, in others entirely dark. Scutum with three narrow black or brown stripes, the outer two curved, sometimes almost straight on anterior portions; pleuræ gray; scutellum sometimes brownish or yellowish, with gray dusting. Abdomen in type gray with opaque brown-black cross-bands on segments 2-5 which occupy the whole disk on center but taper toward sides, segments 6-8 and portion of 9 visible gray-black with a bluish sheen. This coloration is abnormal, in my opinion, and is very probably due to the fact that the specimen was either drawn from the pupa or was prematurely killed. In the great majority of specimens before me, including a large number of the reared specimens of Riley's original series, the abdomen is more or less distinctly banded with black or brown on segments 2-4 only, and there are dorsal spots in varying

¹ Bul. Mus. Hist. Nat. Paris, vol. 13, p. 519.

degrees of intensity on the other segments. Legs black; in some specimens brownish. Wings clear, thick veins yellowish or brownish. Halteres yellow.

Frons narrow, at vertex not occupying one-fourth the width of head, slightly more than one-half as wide at lower angle as at upper angle of eyes, surface hairs pale, weak, and regularly disposed; face distinctly wider than frons at upper angles, one-fourth longer than wide, hairs as on frons; proboscis very short, in none of the specimens projecting more than length of face; palpi black-haired. Scutum with very short, hairlike, regular, but not closely placed, white pilosity, which is longer on posterior fourth; pleural tuft yellowish white; scutellum with pale hairs. Abdominal basal scale gray, the fringe pale yellowish white, all segments with distinct close-lying pile or hairs, which are white in color and much longer at apex and on sides. Legs with close-lying, white, hairlike pilosity and longer, dorsal, pale hairs; hind tarsi with apex of basal joint produced on posterior surface, second joint with basal scale and constriction; claws bifid, as in Plate II, figure 16 (*Prosimulium pleurale*). Hairs on basal portion of wing veins yellowish.

Length, 2-3 mm.

Redescribed from type specimens, Friersons Mill, La., May, 1888, and December, 1889, and a number of other specimens from Nampinka, Manitoba, June 20, 1907 (F. Knab), and Abbeville, Ninety Six, and Greenwood, S. C., April, 1912 (Jennings and King). I have also before me a series of specimens (14) taken in a house at Knoxville, Tenn., by E. C. Cotton, which may be the form described by Townsend as *S. occidentale*.¹ Johannsen considered Townsend's species as a small variety of *meridionale*, the early stages of the former being unknown. The Canadian specimens in this series are much larger (3-4 mm.) than those from Tennessee (1.5-2 mm.) or South Carolina (2.5-3 mm.), but size alone is not a reliable criterion, and structurally the insects appear to me to be identical. It is possible that the early stages may prove different in these forms, but none of the characters given for their separation by Townsend appears to be of specific value in the imagines.

There are some specimens in the collection from Congaree, S. C., April 9, 1912 (Jennings and King), which have the thoracic stripes practically absent, but I do not feel justified in separating them as a distinct species, as in other respects they agree with *meridionale*.²

Male.—Velvety, opaque black. Antennæ slightly yellowish on basal two joints and base of third. Scutum with two anterior marginal pollinose spots of a whitish color, lateral and posterior margins similarly pollinose; when worn slightly the stripes, so distinct on scutum of female, may be indistinctly traced; prescutum

¹ Psyche, 1891, p. 107.

² See Addenda, p. 63.

brownish or yellowish; pleuræ black, paler, brownish, posteriorly, and with whitish pollinosity; scutellum brownish. Abdomen velvety black, sides of first segment, under basal scale, and apical two to three segments whitish pollinose. Legs brown, tarsi darker.

Head of the usual male form in this genus; face hairs pale; postocular cilia pale, with numerous longer, intermixed black hairs. Scutum with rather long, white, hairlike pilosity, which is most closely placed on margins; pleural tuft pale; scutellar hairs white. Abdominal fringe brownish yellow; all segments with pale, rather short, dorsal hairs, and long lateral hairs of same color. Legs with pale hairlike pubescence which is longer than that of the legs of female; claws trifold. The wing venation is as in female, but the wings are vitreous. Halteres brown.

Redescribed from the original specimens bred from same pupal material as the female type.

The larva and pupa of this species bear a strong resemblance to those of *venustum* Say. The larva may be distinguished from that of *venustum* by the absence of the short bristles from the apical joint of the maxillary palpus, the larger size of the central tooth of the labium as compared with the outer lateral one, and also the presence of only three to four ventral lateral bristles. The pupal respiratory filaments number six, but the pairs divide at very near the base instead of, as in *venustum*, appreciably beyond the base.

This species has the reputation of being a biter, but the only record in the collection is that borne by one specimen from Myrtle, Ga., April 3, 1906 (A. A. Girault)—“on Homo,” “found sucking blood from hand.”

Simulium tamaulipense Townsend.

The following is a copy of the original description by Townsend:

♀. Length, $1\frac{1}{2}$ mm. Near *S. meridionale*, but smaller and the outer one on each side of the three thoracic lines not curved outward at posterior end. Eyes velvet black, face and front silvery; the front with usually a trace of linear black vitta in one specimen very distinct, in another entirely wanting. Antennæ yellowish, with a silvery covering. Thorax silvery, with three longitudinal lines; the middle one longest, very narrow and linear; the outer ones heavier, straight, slightly divergent posteriorly. Looked at directly from above, the outer lines appear curved, outwardly convex. Scutellum and metascutum below scutellum, both brownish in some lights but in others they seem to be wholly silvery, the various portions appearing different in color to the view at the same time. Abdomen silvery, but the third and fourth segments wholly brownish, sometimes with a round median silvery spot on each. Legs yellowish, shaded with silvery, tarsi blackish or brownish; hind metatarsi yellowish, except at distal end. Wings clear, whitish, veins dilute pale yellowish. Halteres and wing bases pale dilute yellowish.

Four ♀'s, Reynosa, Tamaulipas [Mexico]. A small species taken on car windows of railway train, May 10th.

Described from four dried specimens.

This description fits *meridionale* in practically every respect, except that the form of the tarsal claws is not indicated. Though the outer stripes are given as "not curved outward at posterior end," they appear to represent a form often met with in this species, where the apices of the side stripes are indistinct. I consider it highly probable that this is merely a synonym of *meridionale* Riley, but I have not seen the types, and there are no disadvantages to be apprehended from retaining *tamaulipense* as a possible distinct species until some one examines the original specimens.

Simulium griseum Coquillett.

Female.—Opaque gray-brown; frons and face thickly white-gray dusted; antennæ brown, the basal two joints and base of third yellow; palpi brown-black. Scutum gray-brown, very thickly covered with white dusting except on center, where there is a more or less distinct longitudinal stripe, and on lateral and posterior margins, where the ground color becomes yellowish; pleuræ gray, paler posteriorly; scutellum yellow; postscutum gray-black. Abdomen tawny yellow, first five segments with a rounded, opaque black, dorso-central spot, that on the segment beneath basal scale the least distinct, remaining segments yellow with slightly darkened dorsum; sometimes in addition to the central spot there are indications of lateral spots on the first four segments. Legs yellow, black as follows: Mid and hind coxæ; entire fore tarsi; hind femora; hind tibiæ; basal three joints of both mid and hind tarsi at apices; and last two joints of mid and hind tarsi entirely. Wings clear, thick veins yellowish. Halteres yellow.

Frons divergent-sided, its width at upper angle of eyes equal to its length from lower to upper angle and one-fourth wider than at lower angle, surface hairs yellow; face as long as frons, subquadrate, surface hairs yellow; postocular cilia pale. Scutum with pale yellow pilosity which is regularly distributed and elongate scale-like, short except on posterior margin; viewed from behind there is an indication of two white spots on the anterior margin of scutum at the inner angle of prescutum; pleural tuft yellow; hairs on scutellum yellow. Abdominal basal scale yellow and yellow-haired; surface hairs on abdomen yellow. Legs with pale yellow pilosity and a few scattered upright brown hairs which are most noticeable at apices and on dorsal surfaces of tarsal joints; basal joint of hind tarsi with apical extension, second with basal scale and constriction, claws as shown in Plate II, figure 7 (*venustum*). Wing venation normal, hairs on wing base not numerous, yellow.

Length, 1.5–2 mm.

Two females marked Colorado, No. 1605 (C. F. Baker); one female Pecos, N. Mex., June 28, on horse (M. Grabham); and three females Inyo County (?), Cal. (A. Davidson).

The first mentioned specimens are the type lot and are slightly smaller than those from California.

Male.—Eyes of the normal form of the males in this genus; face white-pollinose, antennæ brown, paler on basal two joints; postocular cilia pale. Scutum with white pollinosity, which is distinctly pearl-aceous on anterior margin; the whole disk pollinose except a posteriorly abbreviated, central, longitudinal, opaque black stripe, and faint indications of two much shorter lateral stripes; pilosity hair-like, white; prescutum yellow; pleuræ brown, darker on center; scutellum yellow. Abdomen opaque black; segment below basal scale yellow, fifth segment and postero-lateral margins of the apical segments yellow. Legs colored as in female, but the hind femora are only darkened at apices, and the claws are trifid. In other respects similar to female. One specimen, Colorado, No. 1605; no other data. It bears the type label "Cat. No. 10381 U. S. N. M."

The early stages are unknown.

Simulium vittatum Zetterstedt.

Female.—Gray, opaque, or opaque black with very thick gray dusting, except on the portion of body given as black in description. Antennæ brown, basal two joints yellowish; palpi and proboscis brown. Scutum with a straight dorso-central stripe which is sometimes linear, but generally with a brownish suffusion, broadest at anterior third; this stripe reaches the anterior margin and stops at about posterior fourth; on either side of this central stripe there is a bicurved stripe which is triangularly dilated at anterior extremity, then much narrowed, bent inward on anterior half, and bent outward and slightly dilated on its posterior half, joining the central stripe, or almost so, with an inward curve at posterior fourth; laterally beyond these two stripes are other two which stop much short of the prescutum, and also of the end of central stripe; generally these outer stripes are dilated anteriorly; pleuræ unicolorous gray; scutellum slightly darkened on disk. Abdomen with basal scale with a black central spot; first, second, and third segments with a basal crossband of black which is produced centrally; the next three segments with a posteriorly tridentated, black crossband; the fourth and fifth with an additional lateral black spot; apical segments darkened. Legs black, all tibiæ whitish yellow on basal half, the division between the colors generally very abrupt, mid tarsi with basal joint yellow or whitish at base, hind tarsi with two basal joints

pale at base, tibiae whitish dusted, dorsally, at base. Wings clear, thick veins brown. Halteres yellow.

Frons slightly divergent-sided, less than one-third as wide as head at upper angle of eyes, surface hairs pale, sparse; face subquadrate, as broad as frons at upper angle, surface hairs pale, more numerous than on face, postocular cilia pale, with a few intermixed, longer, blackish hairs. Scutum with whitish hairlike pilosity, a few longer, dark hairs in posterior depression; pleural tuft pale; scutellum with upright pale hairs. Abdominal basal fringe white; apical segments of abdomen with sparse, short, white hairs. Legs with white pilosity and longer, brownish, upright, dorsal hairs, fore tarsi slightly dilated, the apical paired hairs absent or very inconspicuous; claws simple (Pl. II, fig. 9). Wing venation normal.

Length, 2-3 mm.

Male.—Opaque, velvety black. Antennæ black, sometimes slightly paler at base. Scutum with anterior, posterior, and lateral margins white pollinose; in some lights there are visible two straight longitudinal dorsal stripes which do not reach beyond middle of disk; in one or two cases there is an indication of the white spots, which show in many specimens of *pictipes* Hagen, on the anterior margin slightly nearer center than stripes; pilosity yellow, hairlike; pleural tuft brownish. Basal fringe of abdomen brown, abdominal segments opaque black, sides of segments 1-3 generally silvery pollinose. Legs colored as in female, but the mid tibiae generally less distinctly pale at base, and the hairs longer; claws trifid. Otherwise as female. Hind leg of male figured on Plate V, figure 2.

There are specimens in the collection which I consider as belonging to this species from the following localities: Glencoe, Nebr. (E. A. Dodge); Richmond, Ind. (W. S. Ratcliff); Minnesota (Lugger); Grand Rapids, Minn., August 18, 1896; Niagara Falls, November, 1896, Pikes Peak, Colo., 10,000 feet, September 17 (T. D. A. Cockerell); Death Valley, Cal., April, 1891 (Koebele); Los Angeles, Cal., July (collection Coquillett); Onaga, Kans., in hog's ear; Yakutat and Kadiak, Alaska, June-July (T. Kincaid); Spartanburg, S. C., July, 1912 (Jennings and King); Sabina, Tex., March 22, 1911 (C. T. Atkinson); Victoria, Tampico, Mexico, December, 1910, biting burros (F. C. Bishopp). There are examples of this species in the Illinois State Laboratory of Natural History collection from Ottawa and Algonquin, Ill. The species has been found commonly in all stages at Havana on the Illinois River. The larvæ and pupæ have been taken in the Illinois River and also in various creeks in Illinois.

There are only two cases in which this species is given as attacking animals in the foregoing list. Johannsen does not give any indication of its habits, but Lugger,¹ in referring to this species as

¹ Bul. 48, Minn. Agr. Exp. Sta., 1896, p. 207.

S. tribulatum, deals at some length with its habits. Its distribution is quite the widest of any of the American species. It may be that there are more than one species in the material before me, but I can not find any characters to separate the Alaskan specimens from those of Mexico. *Argus* Williston is, I consider, identical with *vittatum*. Sometimes the thorax gets wet and the stripes, being visible only through the presence of the pollinosity in good specimens, become indistinct or practically invisible. There is nothing strange in the fact that they are not mentioned in Williston's original description of his species, if his specimen was not in good condition.

The larva, as described by Johannsen, is as follows:

Somewhat mottled gray, the sides of each segment blackish. The head is of the usual reddish brown color; the pale yellow antennæ long and cylindrical, the second joint about one-third the length of the first, the third is a pointed process at tip of the second. The fans have about 40 rays, the cilia being relatively minute. The mandibles are provided with three large apical teeth besides the row of secondary ones; the apical pair of bristles is present. The maxillary palpus has a few spines, and a tuft of a few spines on the basal joint. * * * The labium has an elongated middle tooth, those at the end nearly as long, the intermediate ones short, and there are six bristles in each of the two longitudinal rows on the ventral surface. The three blood gills at caudal end are unbranched.

The pupal respiratory organs are as shown in Plate IV, figure 4.

The cocoon is similar to that of *venustum* Say, and is attached to leaves or plant stems in the water. Occasionally there are only 15, instead of 16, filaments in the respiratory organs. I have seen the pupæ from Spartanburg, S. C. (Jennings and King).

Simulium pictipes Hagen.

Female.—Dark gray, opaque; frons and face very thickly white-dusted; antennæ brown, yellowish on basal two joints; palpi brown-black. Scutum thickly gray-dusted, with three brown or black stripes, the central one straight, the lateral ones curved, and dilated slightly anteriorly, the dilated portion with white pollinose spot when viewed from behind; pleuræ gray, opaque; scutellum and post-scutum concolorous. Abdomen gray, segments 2-4 broadly opaque brown or black-brown on dorsum, the one below basal scale only slightly darker on center. Legs dark gray, only the bases of tibiæ and bases of first tarsal joints of mid and hind legs paler, except in immature specimens, when the legs may be yellowish, but they never show so distinctly bicolored as in *virgatum* or *hunteri*. Wings grayish, the veins rather more distinct than usual. Halteres yellow, darker at base of stalk.

Frons slightly raised in center, divergent-sided, as long as broad at upper angle of eyes, where it is one-fourth wider than at lower angle of eyes; surface hairs white, with a slight admixture of black

ones, most numerous on lateral margins; face as broad as frons at center, slightly longer than broad, the surface hairs yellowish white; palpi black haired; postocular cilia white and black intermixed, the black hairs strongest. Scutum with yellowish white, regular, hairlike pilosity, anterior angles with short intermixed black hairs, posterior fourth with distinct, long, black, upright hairs; pleural tuft whitish; post-spiracular area haired; scutellum with whitish pilosity and upright black hairs. Abdominal basal scale opaque black, fringe pale, whitish; surface hairs on abdomen short, pale yellow or whitish. Legs with whitish pilosity and some upright black hairs, which are most noticeable on dorsal surfaces and tarsal joints, the paired apical fore tarsal hairs not so conspicuous as in *venustum* and its allies; tarsal claws simple (Pl. II, fig. 10).

Length, 3-4 mm.

One female from Ithaca, N. Y., September 2, 1888 (Dr. L. O. Howard), and three reared females from Rosslyn, Va., October 5, 1912 (J. R. Malloch), are in the collection. I have also seen larval, pupal, and adult material from South Carolina (Jennings and King).

Male.—Opaque velvety black. Basal two joints of antennæ slightly yellowish. Scutum with anterior angles and lateral and posterior margins broadly white-pollinose; sometimes there are two small spots on the anterior margin, nearer the center than the large patches on anterior angles of scutum behind prescutum, and in some specimens there are also two central faint whitish longitudinal stripes; pleuræ whitish dusted, postscutum with silky, white pollinosity. Abdomen with first segment under basal scale and sides of fourth to seventh silvered. Legs black, the knees and base of hind metatarsus more or less distinctly yellowish. Wings clear; thick veins brown. Halteres yellow.

Hairs on face and palpi brown, postocular cilia brown; pilosity on thorax yellow and hairlike, short on disk of scutum, longer anteriorly, laterally, and posteriorly, and with a few black, upright hairs intermixed on posterior fourth; pleural tuft pale brown; scutellum with yellow pilosity and long, upright, brown hairs. Basal abdominal fringe brownish yellow, surface hairs on abdomen brown. Legs with yellow pilosity, which is most noticeable on femora and tibiæ, and long, upright, dorsal, black hairs, the paired fore tarsal hairs present on joints 1-3; fore tarsus not thickened, hind tarsus with basal joint narrower than thickest portion of hind tibiæ; claws trifid. Size and venation as in female.

There are a number of specimens before me from Ithaca, N. Y. (Dr. L. O. Howard), most of which have the anterior punctiform marks and dorso-central stripes distinct. The localities for the other specimens in the collection are Rosslyn, Va. (F. Knab), one reared

specimen from same locality (J. R. Malloch), and a reared series from South Carolina (Jennings and King).

Larva.—Length 9 to 12 mm. Sometimes almost entirely black in color. The fans (Pl. III, fig. 5) have about 60 rays which have regularly spaced setæ and slightly shorter and much finer ciliæ between them. The mandibles are as figured on Plate III, figure 2, and respiratory organs as in Plate VI, figure 6. The labium has the central tooth longest and in general outline approaches the *venustum* type of dentation (Pl. III, fig. 4). So far as my experience goes—and that of Messrs. Jennings and King substantiates it—the larvæ of this species are always found on rock surfaces where there is a rapid current, such as on waterfalls, and are difficult of detection owing to their dark color which harmonizes well with that of the rocks. If such conditions are essential to the larvæ it will account for the presence of the species in certain suitable localities and its absence from others where such conditions do not prevail.

Pupa.—The respiratory filaments consist of nine branches (Pl. IV, fig. 2). The cocoons are slipper shaped and yellow-brown in color (Pl. VI, fig. 8). They are placed close together on the rock surface with the open ends pointing downstream. Owing to their pale color and their being placed closely together they are easily seen on the dark surface of the rocks. It is not difficult to obtain imagines from the pupæ if they are kept on damp—not wet—cotton.

The adult female will bite horses, but there is no published record of its attacking human beings that I can find. One specimen in the collection of the U. S. National Museum from Plummers Island, Md., November 3, 1901, bears a label with the word "biting," but Mr. H. S. Barber, who took the specimen, does not recollect the particulars of its capture.

Simulium virgatum Coquillett.

Female.—Black-brown, opaque. Frons and face with thick whitish gray dusting; antennæ brown, the two basal joints yellow; palpi black-brown. Scutum distinctly striped, central stripe narrow, linear, lateral pair curved, the anterior dilated portion filled with white pollinosity forming a pear-shaped spot, the anterior angle of which is as broad as the space between the spots; lateral margins darkened; pleuræ distinctly white-dusted, scutellum concolorous with scutum; postscutum with white silky pollinosity. Abdomen black-brown, opaque on basal four segments, subshining on apical four, all segments with distinct, narrow, white-pollinose fasciæ on hind margins. Legs yellow, brown, or black-brown, as follows: Apices of femora, a narrow ring or spot at bases and apical halves of all tibiæ; entire fore tarsi; apices of first and second and remaining joints of

mid and hind tarsi (Pl. V, fig. 3). Wings slightly grayish, thick veins brown. Halteres yellow.

Frons divergent-sided, above antennæ more than half as broad as at upper angle of eyes, surface hairs brown, upright, and regularly distributed; face not as long as frons and slightly longer than broad, surface hairs pale and shorter than those on frons; hairs on palpi pale; postocular cilia pale, with an admixture of brown hairs. Scutum with white pilosity, which is short, close-lying, and regular except on margins, where it is rather longer and looser; a few short brown upright hairs are present on lateral anterior angles and many longer ones on posterior fourth; pleural tuft grayish white; scutellum with close-lying white pilosity and long, upright, brown marginal hairs. Abdominal basal scale brown, fringe white; segments of abdomen almost bare, only a few scattered brown hairs present, those on apical segments most distinct. Legs with close-lying, short, pale pilosity and longer, brown, upright hairs on dorsal surfaces; the normal paired apical hairs present on the fore tarsi and longer hairs also on hind tarsal joints 2-3; hind tarsi with basal joint produced and second joint with basal scale and constriction (Pl. V, fig. 5); claws with sub-basal tooth (Pl. II, fig. 11). Venation of wings normal except that the cross-vein is at slightly beyond middle of subcosta; hairs on basal part of wing brown, anal marginal hairs white.

Length, 3-4 mm.

Redescribed from the two type specimens from Las Vegas, N. Mex., August (H. S. Barber). These have the scutum indistinctly reddish and differ in this respect only from a series in the collection from Los Angeles, Cal., which was taken in June and July. I can find no other characters which would justify me in separating them as distinct species.

Male.—Opaque black-brown. Face white-dusted; antennæ brown, basal two joints yellowish; palpi black-brown. Scutum with two distinct silvery-white stripes on dorsum; these stripes are anteriorly slightly convergent and terminate with an outward curve on anterior margin of scutum; they do not extend posteriorly beyond the last fourth of disk; lateral margins and anterior angles of scutum white-pollinose; pleuræ white-pollinose; postscutum with silky, white pollinosity. Abdomen opaque black at base, apical three segments slightly shining, first segment below basal scale and fifth almost entirely silvery white, venter yellowish laterally. Legs yellow, blackened as follows: Mid and hind coxæ; apices of all femora and tibiæ as well as slightly at base of latter; entire fore tarsi; apices of basal joint of mid and hind tarsi; apical four joints of mid and all but base of second joint of hind tarsi. Wings grayish, thick veins brown. Halteres with clear yellow knobs and darkened stalk.

Hairs on face pale brown, on palpi brown, postocular cilia dark brown. Pilosity on scutum regular, rather scalelike, golden yellow, a few dark hairs on anterior angles and longer and more numerous hairs of black-brown color on posterior fourth; pleural tuft yellow; scutellum with yellow pilosity and long upright brown hairs; basal fringe and surface hairs on abdomen pale yellow. Pilosity on legs almost white, except on darkened portions where it is pale brown, numerous long pale brown dorsal hairs on all joints, the fore tarsi with paired apical hairs on joints 1 and 3, those on joint 2 not so distinct; fore tarsi not thicker than mid pair, thinner than fore tibiae; hind legs as in Plate V, figure 4; claws trifid. Wings and size as in female.

Redescribed from the type specimen, Las Vegas, N. Mex. (H. S. Barber). There is another specimen from the same locality in the collection, also taken by Mr. Barber.

Nothing is known of the early stages of this species.

Simulium hunteri, new species.

Female.—Black; frons shining black, face white-dusted. Scutum three-striped, opaque; pleurae opaque black, gray-dusted. Abdomen opaque, velvety black on basal four segments, shining black on apical four. Legs black, yellow as follows: Coxae, trochanters, and dorsal surface of tibiae of fore legs; trochanters, bases of femora and tibiae, and basal two-thirds of first tarsal joint of mid and hind legs; basal third of second hind tarsal joint. Wings grayish, thick veins brown; halteres yellow, darkened at base of stalk.

Frons with sides divergent, about two-thirds as wide above antennae as at vertex, undusted, surface with yellow scale-like pilosity and upright black hairs on lateral and posterior margins; face thickly white-dusted, about one-fourth longer than broad, as broad as frons at upper angle of eyes, surface hairs yellow, with some darker, brown ones mixed; palpi black, pale-haired; antennae black, yellowish on basal two and base of third joints. Scutum gray-dusted, with irregularly arranged, golden yellow, scale-like pilosity, and with two large white pollinose spots on anterior margin which are each more than twice as broad anteriorly as the black space between them; these spots are only visible when viewed from behind and occupy the dilated anterior portions of the posteriorly narrower black stripe; viewed from in front and above the dorsum of scutum has a central, black, narrow stripe and two curved stripes beyond them, as well as an indication of a narrow lateral stripe on each side; pleural tuft and hairs on postspiracular area brownish yellow; scutellum with close-lying yellow pilosity and upright black hairs. Abdominal basal scale brown or black, fringe yellow; lateral posterior margins of abdominal

segments gray-dusted, apical segments with numerous black hairs and a few intermixed pale scales, the hairs at apex long. Legs with long, yellow, scale-like pilosity on femora and upright, dorsal, black hairs on these as well as tarsi, the normal paired fore tarsal hairs present on apices of first and third joints; hairs on tarsi concolorous with joints; claws with subbasal tooth (see Pl. II, fig. 3). Wings with venation normal. Halteres pale yellow, darkened at base of stalk.

Length, 3.5-4 mm.

Type.—Cat. No. 15413, U. S. National Museum.

Type locality, Virginia Dale, Colo., September 31, 1912 (collector Bishopp). Submitted for identification by Mr. W. D. Hunter (No. 3065). One specimen from Glenora, British Columbia, and another from Ainsworth, British Columbia, evidently belong to this or a closely allied species, but their condition is too poor to say for certain.

This species is very close to *virgatum* Coquillett, but the legs are much darker in color; this character is very consistent throughout the series of 13 specimens), and the frons is also in most of the specimens entirely glossy black. There is a slight dusting present on one or two of the specimens in the series, but nothing like the thick white pollinosity which is found on that of *virgatum*.

None of the specimens of *virgatum* bear any label as to habits, but the type series of *hunteri* was taken on cows. The early stages are unknown in this species.

Simulium glaucum Coquillett.

Male.—Black, opaque. Antennæ and palpi black; face white-dusted. Scutum with distinct white pollinosity, which is bright silvery on two triangular patches on the anterior margin dorsad of the lateral extensions of the prescutum; central opaque black stripe broad and well defined anteriorly, linear and diffused posteriorly; on either side of this stripe is an abbreviated linear mark which is evidently the rudiment of the dorso-lateral line of *virgatum*, and nearer the lateral margin is a broader black stripe which is diffused on margins and anteriorly abbreviated; pleuræ white-pollinose; scutellum slightly pollinose. Abdomen opaque black, sides of segment below basal scale and apical four segments laterally silvered. Legs black; femora paler at apices; tibiæ and basal joints of mid and hind tarsi broadly yellow at bases; second joint of hind tarsi pale at base. Wings clear, thick veins yellowish. Halteres yellow, base of stalk blackened.

Face hairs and postocular cilia pale. Scutum with white, hair-like pilosity, which is longer posteriorly and on the margins; pleural tuft whitish yellow; hairs on scutellum pale, upright. Basal abdominal fringe yellow, in some lights brown; lateral hairs on abdominal segments white. Legs with pale pilosity and longer,

upright, dorsal pale hairs, which are conspicuous on posterior surface of fore femora; fore tarsi not dilated, the paired apical hairs absent; hind tarsus of the normal *Simulium* form; claws trifid. Surface hairs and short bristles on wing veins brownish yellow.

Redescribed from type specimen. Locality, Kansas City, Mo. (C. F. Adams).

This species belongs to the same group as *virgatum* Coquillett and *hunteri*, new species. The male of the latter is unknown, and it is possible that this may be identical with it, but it is not unlikely that it may belong to a quite distinct species. There is very little resemblance between the males and females of any species in this genus and it is difficult to associate them correctly.

The early stages and the female are unknown.

GROUP E.

Species with two or four stripes on scutum; the stripes straight or very slightly curved. white or pearlaceous pollinose.

TABLE OF SPECIES.

1. Stripes on scutum not curved; scutellum with close-lying yellow pilosity; abdomen with rounded, dorso-central, opaque black spot on basal four segments-----*hematopotum*, p. 62.
- Stripes on scutum slightly curved; scutellum with very indistinct, sparse, yellow pilosity; abdomen with bases of all segments opaque velvety black and apices with whitish pollinosity----*quadrivittatum*, p. 61.

Simulium quadrivittatum Loew.

Female.—Black. Frons and face thickly covered with bluish-white pollinosity; antennæ yellow, distinctly browned from fourth joint to apex; palpi brown-black. Scutum velvety, opaque black; two bluish-white, slightly iridescent, pollinose stripes on the dorsum, which are slightly dilated anteriorly and a little curved; posterior margin of scutum, and lateral margins, as well as prescutum, similarly pollinose; pleuræ with bluish-white pollen; scutellum opaque black; postscutum with iridescent pollen. Abdomen black; basal four segments opaque, with bluish-white pollinosity on first segment below basal scale and on the posterior lateral margins of next three; apical four segments glossy black. Legs black-brown, yellowish as follows: Bases of all tibiæ; mid tarsi except apices of joints and last joint; hind tarsi except apices of joints 1–3. Bases of all tibiæ and of first hind tarsal joint silvery. Wings clear, basal veins brown, thick veins yellow, thin veins colorless. Halteres yellow, stalk black-brown.

Frons slightly divergent-sided, not one-third the head width at upper angle of eyes, almost bare of hairs; face one-third longer than

wide, surface hairs very weak and sparse; hairs on palpi brown; postocular cilia brown. Scutum with yellow, hairlike pilosity; pleural tuft brown, very weak; scutellum with upright brown hairs. Basal fringe of abdomen brownish-yellow, surface hairs on segments brown, weak, except at apex where they become distinctly longer. Legs with brownish-yellow pilosity and scattered, longer upright, brown dorsal hairs; fore tarsi not dilated, first and third joints with paired apical hairs; claws simple. Cross-vein on wing but little beyond middle of subcosta; basal hairs on wing and short bristles on thick veins brown.

Length, 2 mm.

This species was originally described from Cuba and is represented in the collection by specimens from Cayamas, Cuba (E. A. Schwarz); La Palma, Costa Rica (Biolley); and Utuado, Porto Rico, marked "biting flies" (C. W. Richmond). There is also a large series of specimens from Trinidad River and Cabima, Panama, May, 1911 (Busck), which agree with the Cuban specimens, except that the thoracic stripes are less distinct and the specimens average rather less in size and are darker in color.

Nothing is known of the early stages of this species, and the male is also unknown.

Simulium hæmatopotum, new species.

Female.—Black. Frons and face with shining pearlaceous pollinosity. Antennæ yellow, browned from fourth joint to tip; palpi brown, paler at base. Scutum velvety black, with two broad pearlaceous stripes, which are broader at anterior ends than the black space between them, taper slightly posteriorly, but are uncurved; posterior and lateral margins similarly pollinose; pleuræ shining black, with more or less distinct pearlaceous pollinosity; scutellum brown; postscutum with pearlaceous pollinosity. Abdomen brownish; opaque on basal four segments, each of which has a rounded, opaque, black dorsal, and a less distinct lateral spot, posterior margins of these segments whitish dusted; apical four segments with dorsal portions shining; the fifth segment with a rounded dorsal spot, the others almost entirely black. Legs yellow, black as follows: Mid and hind coxæ; fore tarsi; apices of first four and all apical joints of mid tarsi; femora except bases, apical half of tibiæ, apical halves of joints 1-3, and all last two joints of tarsi of hind legs. Wings clear, basal and thick veins yellow. Halteres yellow, stalk blackened.

Frons slightly divergent-sided, less than one-third the head width at upper angle of eyes, surface hairs weak, brownish yellow; face as long as frons and one-half longer than broad, haired as frons; hairs on palpi brown; postocular cilia brown. Scutum with close-lying, golden-yellow, hairlike pilosity; pleural tuft brownish yellow;

scutellum with closely placed yellow pilosity, and brownish, upright, longer hairs. Abdominal basal fringe short, yellow; segments of abdomen with short, sparse, yellow hairs, and longer, dark hairs at apex. Legs with pale yellowish pilosity, which is whitish at bases of tibiae and on basal joint of hind tarsi; dorsal surfaces with longer, blackish, upright hairs; fore tarsi slightly dilated, the paired apical hairs present on joints 1 and 3; claws simple. Wings with brown hairs at base and brown surface hairs on thick veins; cross-vein at two-fifths from end of subcosta.

Length, 1.5–2 mm.

Type.—Cat. No. 15414 U. S. National Museum.

Locality.—Santa Lucrecia, Vera Cruz, Mexico (F. W. Urich). There is also a specimen from Cayamas, Cuba (E. A. Schwarz) which evidently belongs to this species.

The series taken by F. W. Urich is labeled "Bloodsucking, man, October, 1911."

The early stages and the male are unknown.

ADDENDA.

When the manuscript of this paper was under preparation I had considerable doubt as to whether there were not several closely allied forms confused under certain specific names, this being particularly the case with *meridionale*. That size can not always be accepted as a safe guide to the separation of species is abundantly evident to any student of insects, and although in the series of specimens in the National Museum collection there was much disparity in this respect, the specimens presented no tangible characters which, without the confirmatory evidence provided by a knowledge of the early stages, might be accepted as of specific value. Thus I left under one name at least three forms which may in the larval and pupal stages prove to be very dissimilar. The distinctions in the adults are very minute in the genus *Simulium* and are hardly appreciable to anyone unacquainted with the family. I am therefore pleased to have had access to the material belonging to the Illinois State Laboratory of Natural History because of the additional light the material representing the early stages therein contained has cast upon the question of the number of species in the *meridionale* group. Prof. S. A. Forbes has kindly given me permission to include the matter in this addenda as part of my paper.

Simulium forbesi, new species.

Female.—Black, covered with a pale-gray pollinosity, which gives to the insect a pale-gray appearance. Antennæ and palpi black, the former rarely slightly paler at bases. Scutum with three black vittæ, the central one narrow, the outer pair broader, more or less distinctly

curved outward at anterior extremity, and convex on the posterior half; pleuræ gray pollinose, scutellum and postscutellum gray pollinose. Basal abdominal scale gray and next three segments broadly black-brown, opaque, on dorsum, lateral margins gray pollinose, next segment more narrowly blackened on dorsum, the lateral margins and remaining segments gray pollinose. Legs black; generally only the bases of tibiæ yellow, but occasionally, in immature specimens, the black color is confined to the apices of femora, bases and apices of tibiæ, and apices of tarsal joints. Wings clear. Halteres yellow.

Frons at upper angle barely more than one-fifth the head width, slightly converging toward antennæ, the surface with short, white, decumbent pilosity; face distinctly wider than widest part of frons, and longer than wide, the surface with pilosity similar to that on frons; antennal pile short and inconspicuous, whitish; palpi with short whitish pile. Scutum with closely placed pilosity which is hair-like, yellowish white in color, and adheres closely to surface, becoming slightly longer, but not upright, posteriorly; scutellum with much longer pilosity, which is concolorous with that on scutum and upright on margin; pleural tuft whitish, postspiracular area bare. Basal abdominal scale with pale fringe; the hairs on segments of abdomen short and pale. Legs normal in shape; fore tarsi very slightly thickened, the apical, paired hairs not distinguishable; hind tarsi with distinct scale and dorsal excision on second joint; claws bifid; surface of all legs with pale hairs, which are most conspicuous on the tibiæ, giving them a whitish appearance.

Male.—Deep black, opaque. Face silvery pollinose; antennæ and palpi black. Scutum with rarely a slight silvery pollinosity posteriorly and on the lateral margins, and otherwise velvety black; pleuræ slightly covered with white pollinosity; scutellum velvety black; postscutum slightly pollinose, glossy. Abdomen velvety black, only the venter yellowish, no silvery noticeable on any of the specimens before me; hairs on surface short, yellowish. Legs colored as in the female, surface hairs yellow, with an admixture of longer brown upright hairs on the dorsal surfaces. Wings clear, veins pale yellowish, the thin veins very indistinct. Halteres brown.

The head is formed as in other species of this genus, the upper eye facets being conspicuously enlarged while the lower half of the eye has small facets. The scutum is thickly covered with pile, which is golden yellow in color and rather more scalelike than that of the male; there are no upright hairs on disk, and posteriorly the pilosity is decumbent as in the female; scutellum with yellowish pile and upright brownish hairs on margin. Basal fringe of abdomen brownish, the surface hairs also brown. Fore tarsus slender; hind tarsus only slightly dilated; apical paired hairs absent from fore tarsus, or

indistinguishable, hind tarsus formed as in female; claws trifid. Wings normal.

Length, 2–2.5 mm.

Type.—Locality, Illinois River, at Havana. A very large number of both sexes were taken, many of them reared from pupæ which were found in the river. A description of the pupa follows.

Pupa.—Yellow, becoming brown before emergence of the imago, the colors of which may be distinctly traced through the body wall of the pupa some time before it is ready to emerge. The respiratory organs branch near the base, generally into three main stems, the branch or stem which is directed anteriorly again breaking into two stems which are bifid from near their bases; the central stem is again subdivided into three smaller branches, the central one ending in 2 filaments and the other two in 4 each; the posteriorly directed branch generally divides at near to the base, a further subdivision taking place a little farther up, each of the latter branches generally having 2 filaments, making as a rule from 22 to 24 or 25 filaments in all. The abdomen has on the fourth and fifth segments (counting the segment showing just behind the scutellum as the first) a transverse row of four short hooks, the points of which are turned cephalad; on each side of the dorsal line, a somewhat similar series on the eighth segment which are more numerous, smaller, and almost connected in center; on the ninth segment the row is almost continuous on the posterior margin of the segment. The fifth, sixth, seventh, and eighth ventral segments have each two hooks on each side which are much closer, in each pair, to each other than the transverse space between the pairs.

Length, 3–3.5 mm.

The cocoon, which is generally attached to stems of plants or to posts in the stream, is very similar to that of *johannseni*.

The type and paratypes of this species are in the Illinois State Laboratory of Natural History.

I have much pleasure in dedicating this species to Dr. Stephen A. Forbes, who has done so much to elucidate questions in connection with this group on the Illinois River.

Simulium johannseni Hart.

This species is very clearly described by Hart in the Twenty-seventh Report of the State Entomologist of Illinois, 1912, page 32. It is only necessary for me to point out that the male has the three vittæ on the scutum generally distinct and the pilosity whitish. The color of the legs in both species is as given in the description herewith for *forbesi*, although in alcoholic specimens the color is as figured by Hart in his original description. Fresh females of *johannseni*

have the dorso-lateral stripes generally discontinued before the anterior margin and not outwardly curved, as well as the central line extremely narrow; the pilosity over the whole insect is longer than in *forbesi* and conspicuously so on the abdomen; the marking on the abdomen is usually confined to a series of spots, one on each side of the first four segments exclusive of the basal scale. The species is also noticeably larger than either *forbesi* or *meridionale*, being 3-4 mm. in length.

For description of larva and pupa see Hart's paper above mentioned.

It is possible that the larger specimens mentioned as in the U. S. National Museum collection under *meridionale* are really this species, but I have no means of determining that question at present.

So far as my material permits me to judge, *johannseni* occurs at Havana, Ill., till the end of May, when its place is taken by *forbesi*, which is equally abundant.

Simulium meridionale Riley and its allies.

The three species which I at present recognize as belonging to this group are *meridionale* Riley, *johannseni* Hart, and *forbesi* new species.

The pupal stages of these three species, which are very closely allied in the adult stage, are very distinct and may be readily separated from one another by the number of pupal respiratory filaments. In *johannseni* these are 4 in number, in *meridionale* 6, and in *forbesi* generally 24 or 25, although, as is the case when a large number of filaments are present, there may be a slight variation in the total number in individual specimens. *Johannseni* is the only species which I have seen with four pupal filaments, although *bracteatum* has been recorded by Strickland as possessing this number also. I have not seen Strickland's material, so can not confirm the identification.

The adult females of this group of species may be readily distinguished from other North American forms by their possession of the following combination of characters: Scutum with three vittæ, the submedian pair curved; the pilosity hairlike on scutum; abdomen more or less distinctly spotted on middle of each dorsal segment; legs generally almost unicolorous, rarely distinctly bicolored (in alcoholic specimens this bicoloring is conspicuous in the case of *johannseni*); claws bifid. The males are not so readily separated, but I have inserted them in my synoptic key, by means of which I believe they may be readily located.

From the data gathered in the field work on this group in the Illinois River region, near Havana, it is evident that *johannseni*, although a pest owing to the great numbers in which it occurs, does

not appear to be guilty of biting man. It has, on the other hand, been clearly proven that *forbesi* is given to attacking man and also stock. As it occurs in great numbers there is a possibility of its doing considerable damage, although as a general rule it is not very troublesome away from the river. Mr. C. A. Hart has found specimens of *Simulium forbesi* in Mason County, over 5 miles southeast of Havana. As the nearest possible breeding place of the species is the Illinois River, it is evident that the species can fly for a considerable distance. As there was no appreciable diminution in the numbers of the species at this distance it was quite clear that these were not merely accidental stragglers, whose presence was due to their being carried by stock or otherwise, and that the ditches, which are very small in that vicinity and never present favorable breeding quarters at any time, could not possibly have stocked the country so thoroughly with the insects. No extended investigations were carried out to discover the extent of the area covered by the species, but according to reports obtained, and which there is no reason to discredit, the range of the species was considerably wider than ascertained by Mr. Hart. No evidence has been discovered to prove that *johannseni* or *forbesi* live in the larval stage in ditches such as are present in the part of Mason County above referred to.

It may be of interest to mention that the agents of the Illinois State Laboratory of Natural History have found the parasites mentioned by Strickland commonly in *Simulium* larvæ in both the Illinois River and the Sangamon River at near the source of the latter. So far as the records indicate, *vittatum* was the only species affected, but the percentage of parasitized individuals was very large.

In the records of the work done by agents of the Bureau of Entomology many years ago there occurs a note on these parasites, but the fact was not mentioned in any of the published reports on the family.

CATALOGUE OF NORTH AMERICAN AND CENTRAL AMERICAN SIMULIIDÆ.

[^a Types in United States National Museum; ^b Represented in United States National Museum.]

Prosimulium Roubaud. Comptes-Rendus Acad. Sci., Paris, 1906, pp. 519-521.

^a *pleurale* Malloch. This paper, p. 17.

^b *hirtipes* Fries. Monogr. Simulium, 1824, no. 17.

pecuarum Garman (not Riley). Bul. 159, Ky. Agr. Exp. Sta., 1912, p. 18.

^a *fulvum* Coquillett. Proc. U. S. Nat. Mus., vol. 25, 1903, p. 96.

ochraceum Coquillett (not Walker). Proc. Wash. Acad. Sci., vol. 2, 1900, p. 393.

^a *pecuarum* Riley. Rept. U. S. Dept. Agr. f. 1886 (1887), p. 512.

^a *mutatum* Malloch. This paper, p. 20.

Parasimulium Malloch. This paper, p. 24.

^a *furcatum* Malloch. This paper, p. 24.

Simulium Latreille. Hist. Nat. Crust. Ins., vol. 3, 1802, p. 426.

^a *aureopunctatum* Malloch. This paper, p. 27.

^b *subnigrum* Lutz. Mem. Inst. Oswaldo Cruz, vol. 2, part 2, p. 239.

^a *hippovorum* Malloch. This paper, p. 28.

^b *ochraceum* Walker. Trans. Ent. Soc. Lond., vol. 5, 1861, p. 332.

^b *notatum* Adams. Kans. Univ. Sci. Bul., vol. 2, 1904, p. 434.

^a *bivittatum* Malloch. This paper, p. 31.

^a *trivittatum* Malloch. This paper, p. 30.

^a *distinctum* Malloch, Proc. Ent. Soc. Wash., vol. 15, 1913, p. 133.

^b *pictipes* Hagen. Proc. Bost. Soc. Nat. Hist., vol. 20, 1879, p. 305.

innoxium Comstock. Manual for the Study of Insects, 1895, p. 452.

^a *virgatum* Coquillett. Proc. U. S. Nat. Mus., vol. 25, 1903, p. 97.

^a *griseum* Coquillett. Bul. 10, new ser., Div. Ent., U. S. Dept. Agr., 1898, p. 69.

^b *vittatum* Zetterstedt. Ins. Lappon., 1840, p. 803.

argus Williston. Bul. 7, Div. Orn. and Mamm., U. S. Dept. Agr., 1893, p. 253.

? *decorum* Walker. List Dipt. Brit. Mus., vol. 1, 1848, p. 112.

minutum Lugger. Bul. 48, Minn. Agr. Exp. Sta., 1896, p. 202. (Johannsen.)

forbesi Malloch. This paper, p. 63.

^a *meridionale* Riley. Rept. U. S. Dept. Agr. f. 1886 (1887), p. 513.

occidentale Townsend. (?) Psyche, 1891, p. 107.

johannseni Hart. 27th Rept. State Ent. Ill., 1912, p. 42.

tamaulipense. Townsend. Journ. N. Y. Ent. Soc., vol. 5, 1898, p. 171.

^a *hunteri* Malloch. This paper, p. 59.

^b *venustum* Say. Journ. Acad. Sci. Phila., vol. 3, 1829, p. 28.

venustoides Hart. (Female.) 27th Rept. State Ent. Ill., 1912, p. 42.

^a *jenningsi* Malloch. This paper, p. 41.

venustum var. *a* Johannsen. Bul. 68, N. Y. State Mus., 1903, p. 381.

Simulium Latreille—Continued.

- ^a *parnassum* Malloch. This paper, p. 36.
^a *arcticum* Malloch. This paper, p. 37.
^a *clavipes* Malloch. This paper, p. 40.
tarsale Williston. Trans. Ent. Soc. Lond., 1896, p. 268.
pulchrum Johannsen (not Philippi). Bul. 68, N. Y. State Mus., 1903, p. 376.
^b *exiguum* Roubaud. Bul. Mus. Paris, 1906, p. 109.
^b *metallicum* Bellardi. Saggio Ditter. Mess., 1859, vol. 1, p. 14.
^b *mexicanum* Bellardi. Saggio Ditter. Mess. app., 1861-62, p. 6.
^a *bracteatum* Coquillett. Bul. 10, new ser., Div. Ent., U. S. Dept. Agr., 1898, p. 69.
^a *piscicidium* Riley. Amer. Ent., vol. 2, 1870, p. 367.
venustoides Hart, 27th Rept. State Ent. Ill., 1912, p. 42.
tephrodes Speiser. Ins. Börse, 1904, p. 148.
cinereum Bellardi. Saggio Ditter. Mess., vol. 1, 1859, p. 13. Pre-occupied name.
^b *quadrivittatum* Loew. Dipt. Amer. Sept. Ind., Cent. 2, species 2.
^a *hæmatopotum* Malloch. This paper, p. 62.
^a *glaucum* Coquillett. Proc. U. S. Nat. Mus., 1903, vol. 25, p. 97.

UNRECOGNIZABLE SPECIES.

- Simulium irritatum* Lugger. 2d Rept. Ent. Minn., 1896, p. 177.
Simulium invenustum Walker. List Dipt. Brit. Mus., vol. 1, 1848, p. 112.
Simulium molestum Harris. Ins. Inj. Veg., 3d ed., 1862, p. 601.
Simulium tribulatum Lugger. 2d Rept. Ent. Minn., 1896, p. 205. Johannsen gives it as probably a synonym of *vittatum* Zett.

A LIST OF THE PRINCIPAL PAPERS DEALING WITH THE LIFE HISTORIES OF AMERICAN SIMULIIDÆ.

1870. OSTEN SACKEN, C. R.—On the transformations of *Simulium*. <Amer. Ent. and Bot., vol. 2, pp. 229-331.
1880. HAGEN, H. A.—A new species of *Simulium* with a remarkable nymphal case. <Proc. Bost. Soc. Nat. Hist., vol. 20, pp. 305-307.
1880. BARNARD, W. S.—Notes on the development of a black fly (*Simulium*) common in the rapids around Ithaca, N Y. <Amer. Ent., vol. 3, pp. 191-193.
1883. HAGEN, H. A.—*Simulium* feeding on chrysalides. <Ent. Monthl. Mag., vol. 19, pp. 254-255.
1885. RILEY, C. V.—The southern buffalo gnat (*Simulium* sp.). <Rept. Ent., U. S. Dept. Agr. f. 1884, pp. 340-345.
1886. DORAN, E. W.—The buffalo gnat. <Rept. on Econ. Ent. of Tenn. to the Bureau of Agr. Stat., Mines, and Immigr., pp. 239-242.
1887. WEBSTER, F. M.—Report on buffalo gnats. <Bul. 14, Div. Ent., U. S. Dept. Agr., pp. 29-39.
1887. RILEY, C. V.—Buffalo gnats. <Repts. Ent., U. S. Dept. Agr. f. 1886, pp. 492-517.
1889. WEBSTER, F. M.—*Simulium* or Buffalo gnats. <Rept. Bur. Anim. Ind., U. S. Dept. Agr. f. 1887 (1889), pp. 456-465.
1892. WEBSTER, F. M.—Buffalo gnats (*Simuliidæ*) in Indiana and Illinois, Proc. Ind. Acad. Sci., December, 1892, pp. 155-159.

1895. TOWNSEND, C. H. T.—On the correlation of habit in nemocerous and brachycerous Diptera between aquatic larvæ and bloodsucking adult females.<Journ. N. Y. Ent. Soc., vol. 3, pp. 134-136.
1895. MIALl, L. C.—The natural history of aquatic insects. *Simulium*, pp. 175-188.
1896. LUGGER, O.—Buffalo gnats, black flies.<2nd Ann. Rept. Ent. State Exp. Sta., Univ. Minn., pp. 172-182.
1896. OSBORN, H.—Insects affecting domestic animals.<Bul. 5, new ser., Div. Ent., U. S. Dept. Agr., pp. 31-58.
1901. KELLOGG, V. L.—Food of larvæ of *Simulium* and *Blepharocera*.<Psyche, vol. 9, pp. 166-167.
1901. NEEDHAM, J. G., and BETTEN, C.—Aquatic insects of the Adirondacks. <Bul. 47, N. Y. State Mus., pp. 393, 407-408, 574.
1902. TAYLOR, T. H.—On the tracheal system of *Simulium*.<Trans. Ent. Soc. Lond., 1902, pp. 701-716.
1903. JOHANNSEN, O. A.—Aquatic nematocerous diptera.<Aquatic Insects in New York State, pt. 6, Bul. 68, N. Y. State Mus., pp. 336-388.
1904. WEBSTER, F. M.—The suppression and control of the plague of gnats in the valley of the lower Mississippi River, and the relation thereto of the present levee system, irrigation in the arid West, and tile drainage in the Middle West.<Proc. 25th Ann. Meet. Soc. Prom. Agr. Sci., pp. 53-72.
1905. HEADLEE, T. J.—Blood gills of *Simulium pictipes*.<Amer. Nat., vol. 41, pp. 875-885.
1909. LUTZ, DR. A.—Brazilian Simuliidæ.<Mem. Inst. Oswaldo Cruz, vol. 1, pt. 2, pp. 124-146.
1910. LUTZ, DR. A.—Brazilian Simuliidæ.<Mem. Inst. Oswaldo Cruz, vol. 2, pt. 2, pp. 213-262.
1910. STRICKLAND, E. H.—Some parasites of *Simulium* larvæ and their effects on the development of the host.<Biol. Bul., vol. 21, no. 5, October, 1911, pp. 302-334.
1912. GARMAN, H.—A preliminary study of Kentucky localities in which pellagra is prevalent.<Bul. 159, Ky. Agr. Exp. Sta.
1912. FORBES, S. A.—Black-flies and buffalo-gnats (*Simulium*) as possible carriers of pellagra in Illinois.<27th Rept. State Ent. Ill., pp. 21-55.
1913. STRICKLAND, E. H.—Further observations on the parasites of *Simulium* larvæ. Journ. Morph., Phil., vol. 24, p. 43.

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<i>innoxium</i> (<i>Simulium</i>)	68	<i>tribulatum</i> (<i>Simulium</i>)	55
<i>invenustum</i> (<i>Simulium</i>)	13	<i>Trichocera</i>	12
<i>irritatum</i> (<i>Simulium</i>)	13	<i>trivittatum</i> (<i>Simulium</i>)	29, 30
<i>jenningsi</i> (<i>Simulium</i>)	14, 25, 34, 41	<i>venustoides</i> (<i>Simulium</i>)	46
<i>johannseni</i> (<i>Simulium</i>)	15, 25, 34, 47, 65	<i>venustum</i> (<i>Simulium</i>)	8, 10, 14, 15, 26, 34, 43
<i>lineatum</i> (<i>Simulium</i>)	27	<i>venustum</i> var. <i>a</i> (<i>Simulium</i>)	42, 45
<i>lutzi</i> (<i>Simulium</i>)	14	<i>virgatum</i> (<i>Simulium</i>)	26, 48, 57
<i>maculatum</i>	12	<i>vittatum</i>	13, 14, 15, 26, 48, 53
<i>Melusina</i>	12		
<i>meridionale</i> (<i>Simulium</i>)	14, 15, 47, 49 , 51 , 66		

PLATE I.

ANATOMICAL DETAILS AND WING VENATION OF SIMULIIDÆ.

Fig. 1.—Lateral view of thorax of *Prosimulium pleurale*: n_1 , Pronotum; pse_2 , proscutum; set_2 , scutum; scl_2 , scutellum; pn_2 , mesothoracic postnotum; n_3 , metanotum; pn_3 , metathoracic postnotum; pph , postphragma; w , wing; h , haltere; $sp_{1,2}$, prothoracic and mesothoracic spiracles; $eps_{1,2,3}$, prothoracic, mesothoracic, and metathoracic episterna; $epm_{1,2,3}$, prothoracic, mesothoracic, and metathoracic epimera; m , membranous area; $ps_{1,2,3}$, prothoracic, mesothoracic, and metathoracic sutures; $wp_2, 3$, pleural wing sutures; ppt , postparapтерum; s_2 , divided mesosternum; $cx_{1,2,3}$, coxæ; abs , abdominal basal scale. The pleural tuft occupies the area covered by the letters ppt and wp_3 in figure.

2.—Wing of *Simulium*: A , humeral vein; B , costa; C , subcosta; D , first longitudinal vein; E , upper branch of radius or third longitudinal vein; F , lower branch of radius; G , fourth longitudinal vein or medius; H , fold which has been sometimes considered as the cubitus; I , cubitus or fifth longitudinal vein; in cases where the fold has been reckoned as the cubitus this vein has been named the anal vein.

3.—Wing of *Prosimulium*. (Explanation as in fig. 2.)

4.—Wing of *Parasimulium*. (Explanation as in fig. 2.) (Original.)

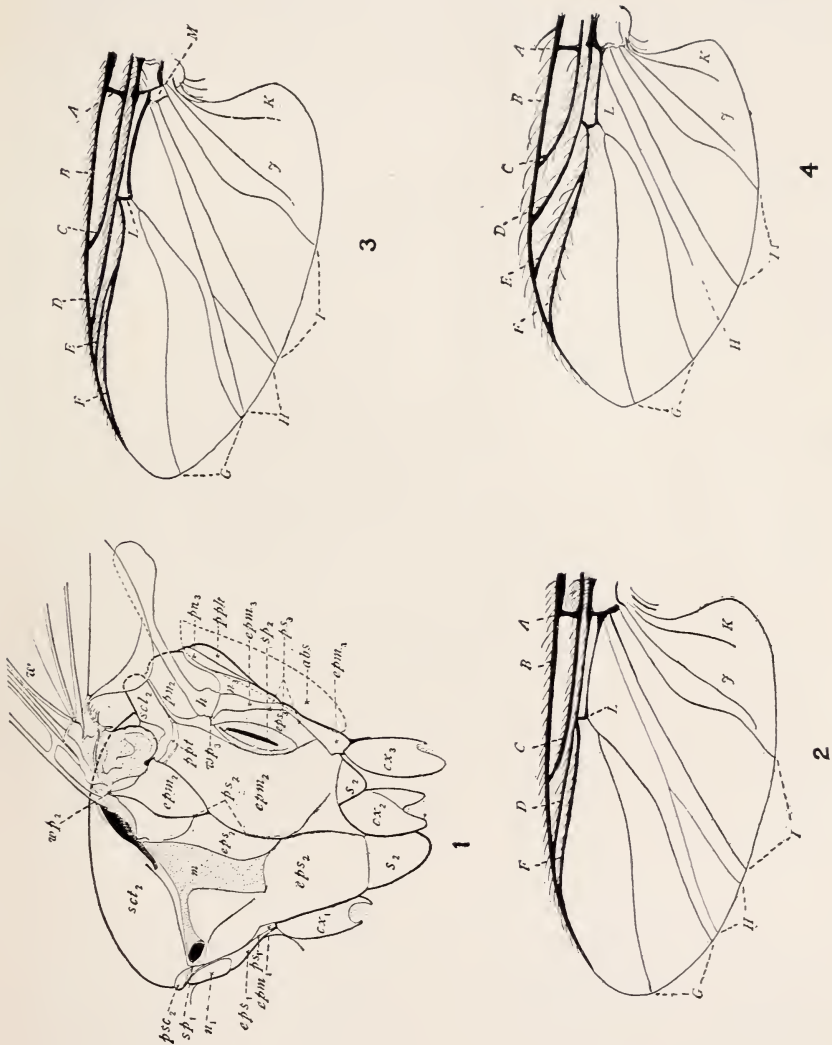
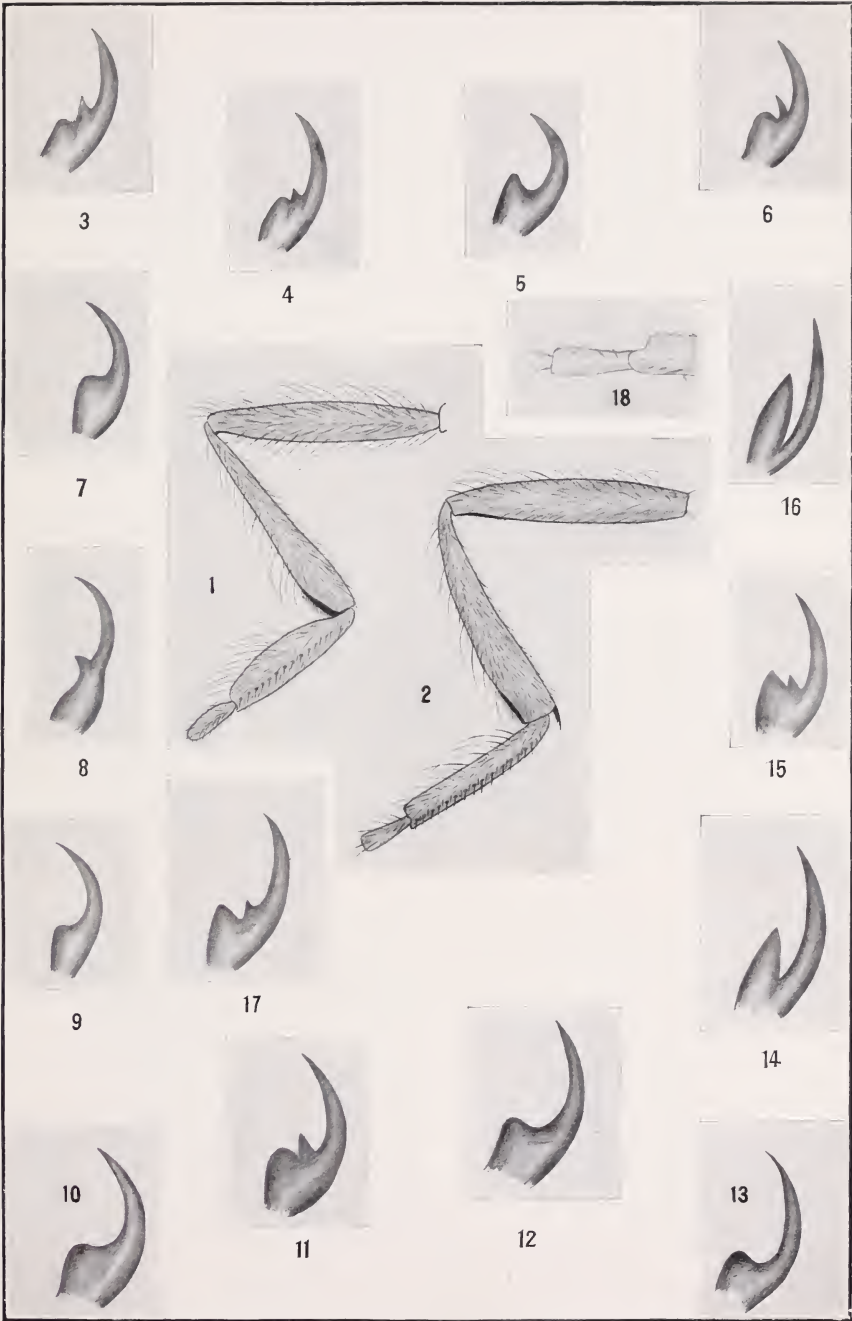


PLATE II.

LEGS AND TARSAL CLAWS OF SIMULIIDÆ.

- Fig. 1.—Hind femur, tibia, and two basal tarsal joints of *Prosimulium fulvum*, male.
- 2.—Same of *Prosimulium pecuarum*, female.
- 3.—Claw of *Simulium hunteri*, female.
- 4.—Claw of *Simulium arcticum*, female.
- 5.—Claw of *Simulium claripes*, female.
- 6.—Claw of *Simulium mexicanum*, female.
- 7.—Claw of *Simulium venustum*, female.
- 8.—Claw of *Simulium parnassum*, female.
- 9.—Claw of *Simulium vittatum*, female.
- 10.—Claw of *Simulium pictipes*, female.
- 11.—Claw of *Simulium virgatum*, female.
- 12.—Claw of *Simulium hippororum*, female.
- 13.—Claw of *Prosimulium fulvum*, female.
- 14.—Claw of *Prosimulium pecuarum*, female.
- 15.—Claw of *Simulium ochraceum*, female.
- 16.—Claw of *Prosimulium pleurale*, female.
- 17.—Claw of *Simulium metallicum*, female.
- 18.—Apex of basal and second joint of hind tarsus of *Prosimulium mutatum*, female. (Original.)

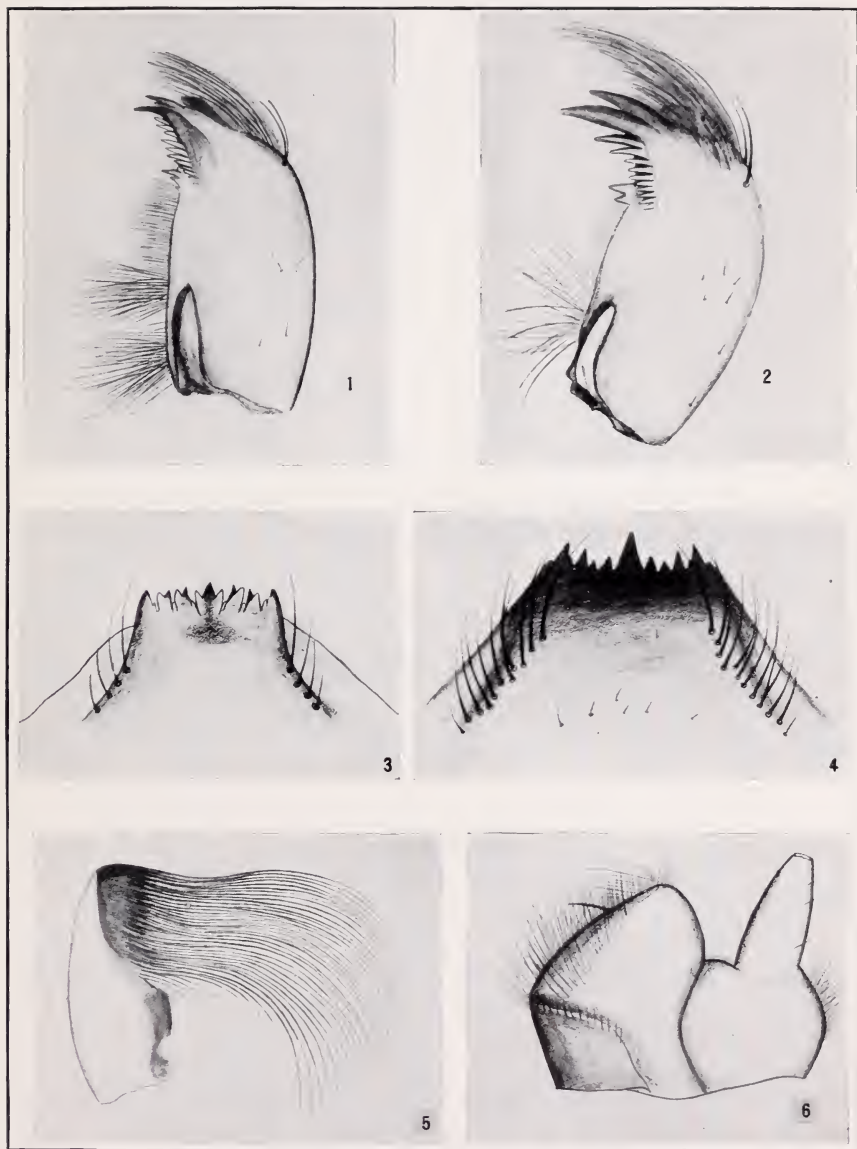


LEGS AND TARSAL CLAWS OF SIMULIIDÆ.

PLATE III.

LARVAL CHARACTERS OF SIMULIIDÆ.

- Fig. 1.—Mandible of larva of *Simulium jenningsi*.
2.—Mandible of larva of *Simulium pictipes*.
3.—Labium of larva of *Prosimulium hirtipes*.
4.—Labium of larva of *Simulium pictipes*.
5.—Fan of larva of *Simulium pictipes*.
6.—Maxilla of larva of *Prosimulium hirtipes*. (Original.)

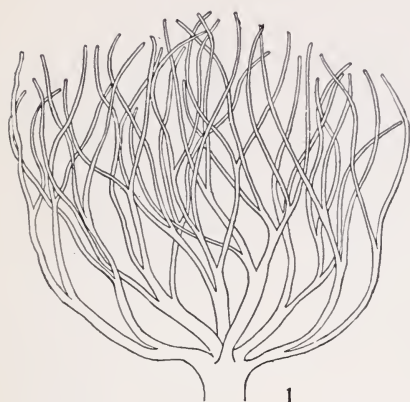


LARVAL CHARACTERS OF SIMULIIDÆ.

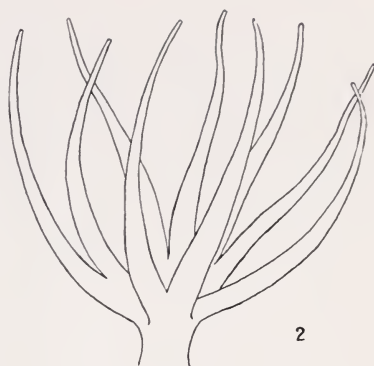
PLATE IV.

RESPIRATORY FILAMENTS OF PUPÆ OF SIMULIIDÆ.

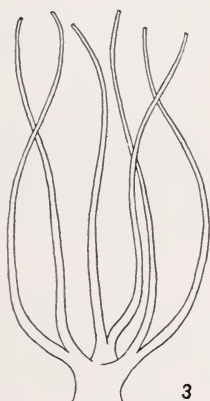
- Fig. 1.—*Prosimulium peculiarum*.
2.—*Simulium pictipes*.
3.—*Simulium venustum*.
4.—*Simulium vittatum*.
5.—*Prosimulium hirtipes*.
6.—*Simulium meridionale*. (Original.)



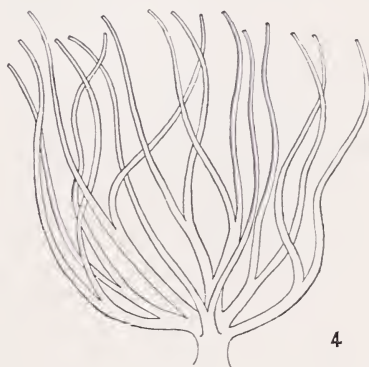
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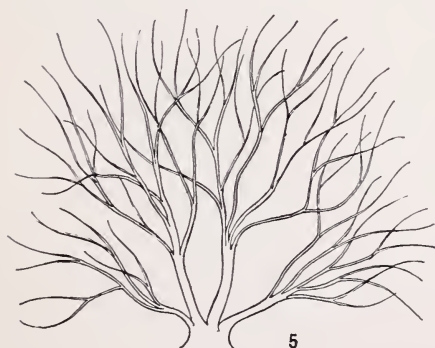
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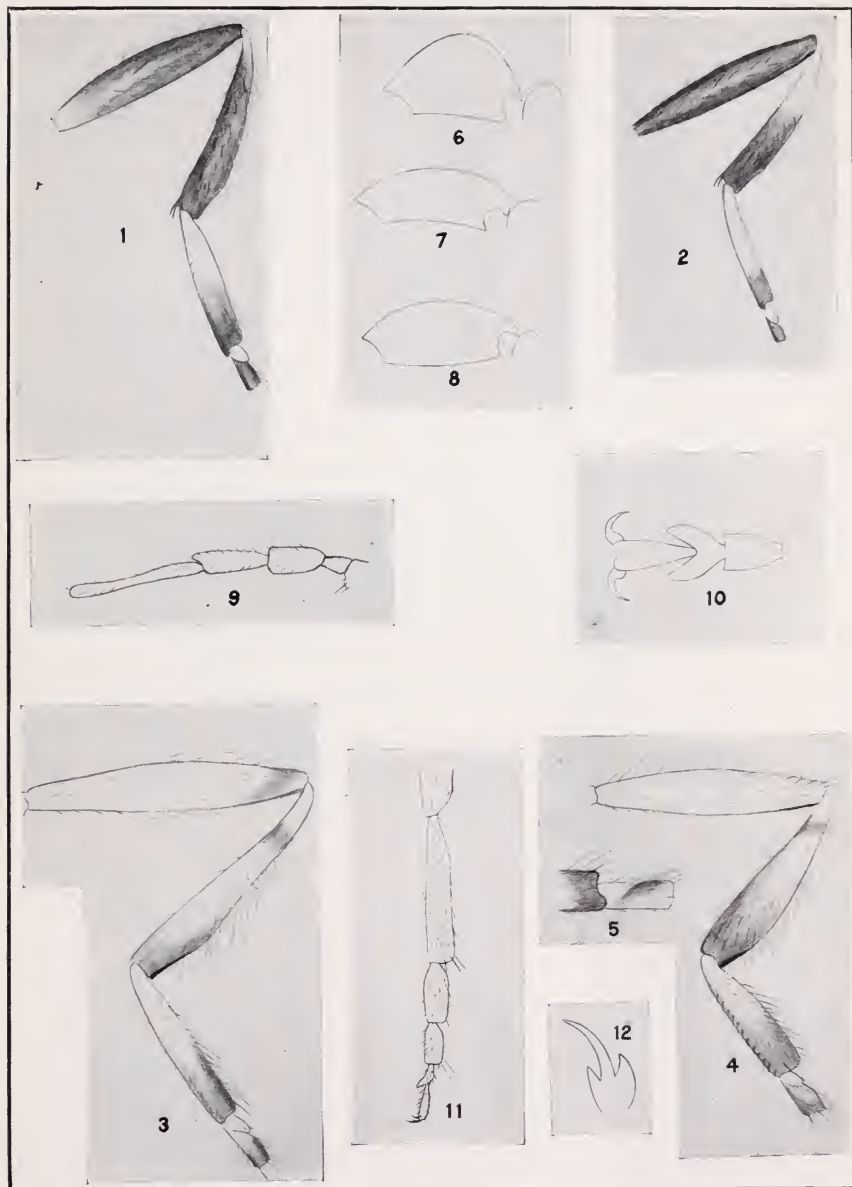
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RESPIRATORY FILAMENTS OF PUPÆ OF SIMULIIDÆ.

PLATE V.

ANATOMICAL DETAILS OF SIMULIIDÆ.

- Fig. 1.—Femora, tibiæ, and basal two joints of tarsus of hind leg of *Simulium venustum*, male.
- 2.—Same of *Simulium vittatum*, male.
- 3.—Same of *Simulium virgatum*, female.
- 4.—Same of *Simulium virgatum*, male.
- 5.—Apex of first and whole of second joint of hind tarsus of *Simulium virgatum* from posterior side.
- 6.—Side elevation of scutum of *Simulium notatum*, female.
- 7.—Same of *Simulium bivittatum*, female.
- 8.—Same of *Simulium ochraceum*, female.
- 9.—Palpus of *Simulium piscicidium*, female.
- 10.—Last three tarsal joints in *Simulium*.
- 11.—Fore tarsus of *Simulium parnassum*, female.
- 12.—Tarsal claw of *Simulium jenningsi*, male. (Original.)

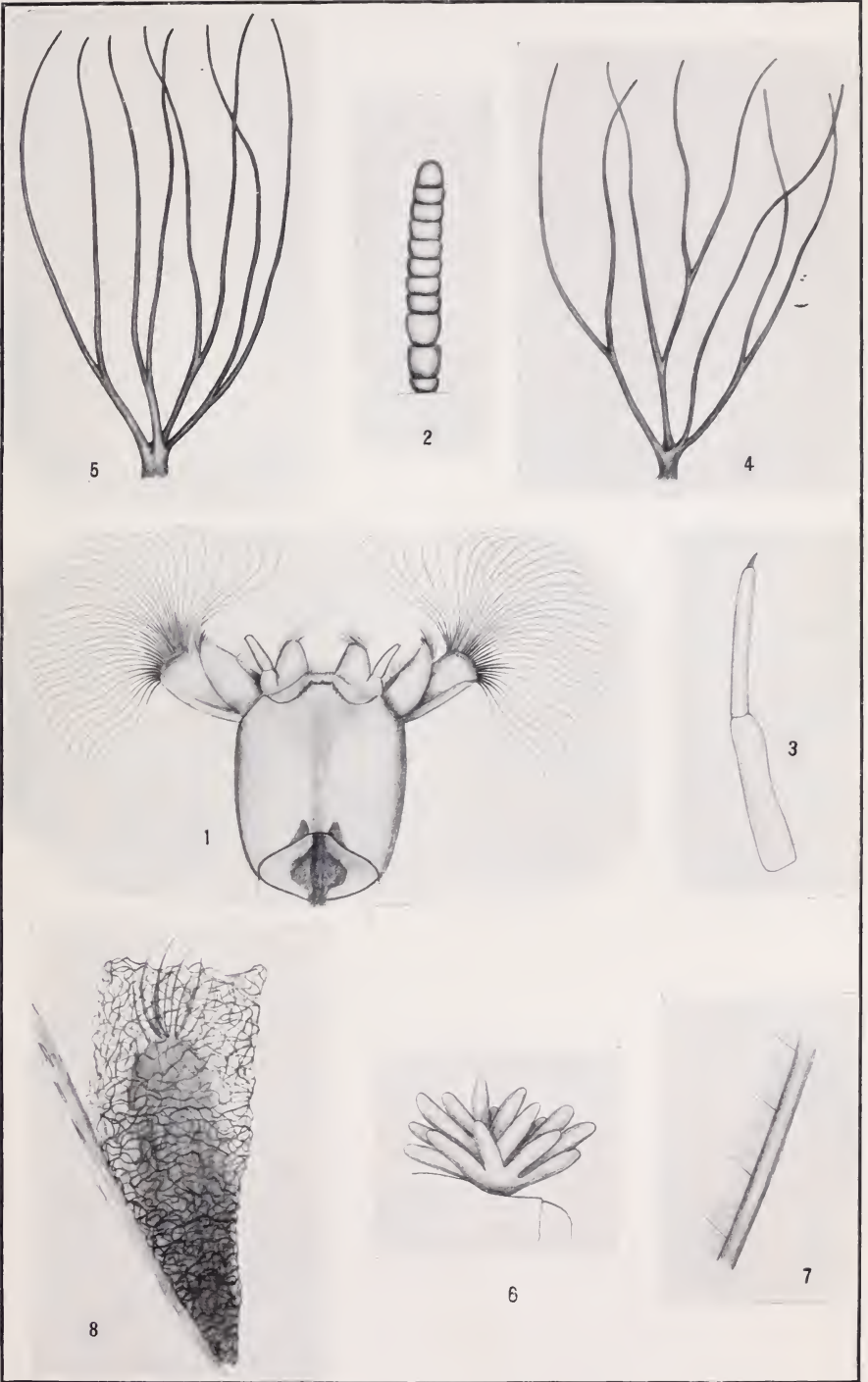


ANATOMICAL DETAILS OF SIMULIIDÆ.

PLATE VI.

ANATOMICAL DETAILS OF SIMULIIDÆ.

- Fig. 1.—Head of larva of *Simulium meridionale* from ventral aspect
2.—Antenna of *Simulium*, imago.
3.—Antenna of *Prosimulium hirtipes*, larva.
4.—Pupal respiratory filaments of *Simulium metallicum*.
5.—Pupal respiratory filaments of *Simulium piscicidium*.
6.—Larval respiratory filaments of *Simulium pictipes*.
7.—Portion of ray of mouth fan of *Prosimulium hirtipes*, larva.
8.—Cocoon of *Simulium pictipes*. (Original.)



ANATOMICAL DETAILS OF SIMULIIDÆ.



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